

A Comparison of Course Practices and Student Outcomes in Traditional Lecture Versus Modified Flipped Algebra I Classrooms

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Abstract

This study compared course teaching practices and student outcomes in 7 Algebra I classes taught in a modified flipped format and 7 classes in the same high school taught in a traditional lecture format during the same year. There were 4 teachers and about 200 hundred randomly assigned students in each format during the experimental year. The study also compared student outcomes of the students in the experimental year with those of students of the same teachers in the previous year when all classes were taught in the traditional lecture format.

Based on interviews with the teachers, the study found that for the most part, the instructional flipped format was implemented with fidelity, i.e., the teachers carried out the modified flipped program as intended and in a manner that constituted a significant departure from the traditional lecture format. The study also found that students in the modified flipped classes scored higher on the Missouri State End of Course (EOC) algebra exams than those in the traditional lecture classes. However, examination of EOC data for the previous year revealed a similar pattern in the performance of each teacher's students. In fact, the students of the teacher whose classes outperformed the others when taught using the modified flipped format outperformed the others by an even greater margin when all classes were taught using the traditional lecture format. Based on these findings, the study concluded that the observed difference in scores could not be attributed to the use of the modified flipped format.

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Chapter 1: Introduction

Background:

This study is a comparison of course teaching practices and student academic outcomes in traditional lecture versus modified flipped Algebra I classrooms. The target site for this study is a medium-sized high school located in the Northern part of the greater Kansas City Area. Student end of course (EOC) exam data and teaching practice data from the 2013-14 along with EOC data from 2012-13 school year was used for the study. During that time, the target district consisted of nineteen operational schools: twelve elementary schools, four middle schools, two high schools, and one alternative school. This study used interview data from four Algebra I teachers in conjunction with students' EOC exam scores collected from the target high school.

According to the Department of Elementary and Secondary Education (DESE), the target district's total student enrollment during the 2013-14 school year was 11,200 students with approximately 5600 females and 5600 males. The district's white population during this time was 80 percent, 20 percent were nonwhite, and 20 percent were eligible for free/reduced lunches. The target high school where this study's data was mined had a student population of 1500 with 80 percent white, 20 percent nonwhite, and 21 percent eligible for free/reduced lunches. For comparison, Missouri's average white population during the same time period was 73.3 percent and nonwhite was 26.7 percent with 49.9 percent of students eligible for free/reduced lunches.

During the 2012-13 school year, the target site district's Board of Education sanctioned funding to provide every secondary student with a personal laptop. Laptops were subsequently distributed to each student at the beginning of the 2013-14 school year with an expectation that teachers would implement teaching methodologies that capitalized on technology while improving student outcomes. District leaders believed the substantial financial investment in new technology demanded an equally substantial investment in data-driven teacher training

opportunities so students may maximize the benefits of their new technology. Building leaders wanted to avoid students utilizing their laptops as note taking machines and teachers symbolically implementing technology in-class with minimal academic value. Rather, the goal of building administrators was an empirically driven experimental study that would dictate future instructional methodologies utilizing technology that may yield increased student outcomes.

To assist in this objective, building leaders conducted a pilot study using Algebra I students and compared their academic outcomes between modified flipped classrooms and traditional lecture classrooms. The definition and rationale for choosing modified flipped methodology along with the reasons behind choosing Algebra I for the experimental trial as opposed to other teaching practices and core subjects will be explored in subsequent sections.

To begin the study, school leaders used *PowerSchool* student information systems to randomly divide the freshman Algebra I class ($n = 393$ students) into two groups. Group one ($n = 197$) received Algebra I instruction via modified flipped methodology and group two ($n = 196$) received Algebra I instruction via traditional lecture methodology. At the end of the school year, student outcomes were checked for statistical differences in content knowledge as measured by Algebra I EOC exam scores between the two groups. Results were used to determine if modified flipped methodology impacted student outcomes versus traditional lecture practices. If the answer was yes, then teacher training on proper implementation of modified flipped methodology using laptops could be implemented district-wide with hopes of replicating the pilot's findings. If the answer is inconclusive or no, then more research is needed or different applications for student laptops would be explored.

Purpose for Study

As traditional lecture practices come under criticism, school leaders are pursuing alternative teaching methodologies that may improve student critical thinking skills, engagement, and outcomes (Dixson, 2012). One teaching methodology that has been gaining attention over the past decade is the flipped learning model (Horn, 2013). As flipped learning evolves and the cost to purchase student laptops decreases, increased availability of laptops, and necessary maintenance declines, school leaders may find themselves increasing the usage of flipped learning practices in their schools (Bishop & Verleger, 2013).

Flipped learning models earned their name by inverting, reversing, or flipping in-class instruction and out-of-class homework (Horn, 2013). Traditional lecture classrooms typically provide the instruction during in-class time and homework outside of class and may be absent of teacher support. Flipped classrooms provide the instruction outside of school hours via teacher web-based recordings or narrated lesson screencasts, videos of them teaching, or purchased video lessons from reputable online resources. This model facilitates students' first exposure to learning before class so they focus on the processing part of learning such as synthesizing, analyzing, collaborating, and problem-solving in class (Brame, 2013). Next, the teacher used in-class time to address any parts of the lesson students had additional questions or requested sample problems solved step-by-step on a SMART board. After that, students solved assigned Algebra I problems in class using collaborative learning techniques with teacher support. More in-class time was available for students since the bulk of the lesson was viewed outside of school hours. As a result, students had more in-class time for collaboration and guided support from their teacher. The additional teacher support and collaborative practices led to more in-depth understanding, engagement, and retention of the lesson (Dixson, 2012). Furthermore, this study

focused on an enhanced version of flipped learning, dubbed modified flipped learning, which added two additional components that compliment flipped practices. Modified flipped practices will be defined in the next section.

Before describing additional reasons for increased interest in flipped learning, it is important to define the term “collaborative learning” since it will be used extensively throughout this study. Collaborative learning should not be confused or interchanged with cooperative learning since they are separate forms of learning practices. Collaborative learning is a harmonized and synchronized activity that results in an ongoing attempt by generally pairing students to assemble and preserve a shared conception of a problem (Hallinger, 2011). It refers to any instructional practice in which students work in groups of two towards a common learning objective (Mullen, & Hutinger, 2008). At the core of collaborative learning is the emphasis on peer interactions as opposed to learning as a solitary activity (Tolmie, Topping, Christie, Donaldson, Howe, Jessiman & Thurston, 2010). The central element of collaborative learning is mutual as opposed to individual and focuses on possible improvement of learning outcomes (Hallinger & Heck, 2010).

Experts who studied collaborative learning have found some possible benefits to this learning practice. Hallinger (2011) findings suggest the more time spent in small groups the greater student attitudes and outcomes. In particular, Wang (2009) research implied collaboration augments academic outcomes, student attitudes, and student retention. DeWitt, Siraj & Alias (2014) findings suggest the regularity and significance of these results may benefit students academically, personally, and socially from collaborating in their classes. This supports the premise that collaboration may be effective for encouraging a wide collection of student

learning outcomes. The theoretical underpinnings behind collaborative learning and possible improved student outcomes associated with it will be discussed in the literature review.

Cooperative learning on the other hand is defined as a controlled group effort where students pursue shared goals while being assessed independently by peers or teachers (DiDonato, 2013). A common model of cooperative learning incorporates five key aspects. It assigns each group member a specific task. These include individual responsibility, mutual interdependence, face-to-face peer interaction, proper usage of interpersonal skills, and on-going self-assessment of team performance (Volet, Summers & Thurman, 2009). There are various cooperative learning models that exist but the central aspect is a focus on cooperative incentives as opposed to competition to promote learning. For example, a group of five students may be using flash cards to review various Algebra I concepts. In this example, one student acts as the time keeper, one holds the flash cards, one answers the questions, one keeps score, and another acts as a coach offering encouragement. At the end of the assigned time, students rotate to a different role until each student performs all five tasks.

Another reason for the increase in flipped methodology experimentation is the addition of new electronic devices constantly emerging to support the out-of-class component of school curriculum (Bell, 2015). More specifically, the continued expansion of affordable and powerful mobile devices that may provide students with educational tools they can use at times and places most suitable for them (Milman, 2012). In the future, typical school days may no longer consist of teachers using class time to convey a particular lesson solely through lecture or small group instruction (Staker & Horn, 2012). Rather, the use of prerecorded asynchronous web-based videos puts lectures under the power of the student. For example, they can watch, pause, rewind, and fast-forward as desired. This flexibility may be of value to students with accessibility

concerns, particularly where closed captions are provided for students with hearing impairments. Online lectures are viewed as often as needed and may prove beneficial for many students but especially favor English Language Learners (Bishop & Verleger, 2013). Furthermore, class time can be transformed into a workshop where students inquire about video content, test their skills in practical applications, and collaborate with other students in hands-on activities (Bell, 2015). During class sessions, teachers operate as guides or coaches that encourage student analysis and collaborative endeavors as opposed to traditional lectures that may not be effective for some students (Baepler, Walker & Driessen, 2014).

School administrators may want to consider that an increasing number of courses may exploit vital elements of flipped learning (Dixson, 2012). Essential components such as supplementing traditional out-of-class lectures with web-based videos, capitalizing on supporting online resources such as Google Docs or Facebook, and incorporating technology into project-based learning during regular class times are becoming more pervasive in schools (Bell, 2015). As a result, practitioners in educational leadership may want to reflect on the ever changing advancements and correct usage of technology in classrooms so they can appropriately train teachers and students on the most effective methods of flipped learning that may impact student outcomes (Christensen, Horn & Staker, 2013).

Lastly, school leaders who lack the proper theoretical framework along with practical application and knowledge about modified flipped learning may struggle to properly implement it (Bell, 2015). Without proper implementation and adherence to methodological fidelity, flipped learning may not produce results advocates suggest (Brahimi & Sarirete, 2015). Consequently, instead of full compliance, it may yield symbolic adoption by students and teachers (Roehl, Reddy & Shannon, 2013). However, if enacted with fidelity, flipped learning

may impact student outcomes along with corresponding teaching practices (Herreid & Schiller, 2013).

Rationale and Definition of Modified Flipped Methodology

Algebra I is an essential core course for many secondary students. It provides the underpinnings for future high school mathematics courses while providing foundational knowledge for students who are pursuing a career in mathematics or science related disciplines (Love, Hodge, Grandgenett & Swift, 2014). Algebra I may also be a difficult subject for students to comprehend. Research confirms that Algebra I is one of the most conceptually difficult and foundationally critical subjects in secondary curriculum (Schultz, Duffield, Rasmussen, & Wageman, 2014). Bush & Karp (2013) findings suggest Algebra I can be difficult to grasp due to the abstractness, richness of the content, and frequency of instructional practices involving teacher-centered or traditional lecture contexts.

Johnson & Johnson (2009) findings on current high school students, also known as Millennials 1981-96, have distinctive learning preferences that diverge from past generations. Demetry (2010) analysis implied millennial students prefer peer collaboration, active-based education, and technology infused curriculum. According to Kirschner, Strijbos, Kreijns & Beers (2004) research, they favor instructors that foster collaboration with their classmates, incorporated technology in homework and instruction, and flexible learning settings. Based on findings by Roehl, Reddy & Shannon (2013), traditional lecture practices for Algebra I may not be the most ideal methodology for millennial and Generation Z learning styles.

Additionally, Christenson, Reschly, & Wylie (2012) research suggested traditional lecture practices have been criticized for minimal student engagement in the learning process while focusing on the teacher. Horn's (2013) findings implied that lecture methodology may

reduce student engagement since the focus is on listening and note taking. After observing several lecture practices, Brame (2013) findings proposed that students were encouraged to retain and process information while receiving oral instruction from the instructor. This practice may work for some; however Melton, Bland, & Chopak-Foss (2009) research supports that other students produced improved outcomes with curriculum that fosters engagement with active participation.

Increasing criticisms and lack of student engagement directed at traditional lecture practices provided the motivation for target site district leaders to investigate other alternative teaching methodologies that may increase student centeredness while improving outcomes. One alternative teaching methodology, flipped learning, involves the introduction of laptops and/or tablets in the classroom. The mounting availability and affordability of laptops, along with increased internet access has augmented school leader experimentation with technology in instructional practices (Demetry, 2010). The teaching practice implemented by the cooperating high school, modified flipped, capitalizes on laptop technology that is rooted in the flipped classroom model.

As discussed earlier, flipped teaching practices earned their name by inverting or flipping in-class instruction and out-of-class homework (Horn, 2013). Flipped advocates have several reasons for their teaching practices. For example, Vaughan (2014) research findings imply that flipped classes may enhance active learning and result in more student centeredness. According to Horn (2013), his findings suggest students can view videos as often as necessary, possibly creating more dynamic and engaged learners in the classroom. Milman (2012) research found that flipped classrooms deliver direct instruction outside of school hours so teachers may utilize in-class time to actively engage students in their academic development collaboratively while

providing individualized guided support and inquiry. These recent flipped learning studies suggest some possible advantages compared to the traditional lecture model, but it does have some weaknesses.

The most significant disadvantage of flipped learning is that some students will not view the out-of-class web-based instructional video and consequently are not prepared for the collaborative learning component in subsequent classes. In order for flipped learning methodology to be effective, students must spend the appropriate time and effort viewing out-of-class videos. Brame (2013) findings suggest that failure to complete this aspect of flipped learning may negatively affect student outcomes as well as instructor satisfaction. The target district's school leaders were aware of these potential weaknesses and chose to supplement the flipped learning model with additional components with expectations of increasing student participation in out-of-class activities. Flipped classrooms with these additional components will be referred to as modified flipped in this study.

A modified flipped classroom adds additional tasks to enhance student participation, engagement, and provide essential corrective feedback (Vaughan, 2014). The modified flipped methodology retains the teacher web-based videos or screencasts with narration but incorporates two additional features. First, before students watch the video, they are provided with a few teacher generated web-based questions they access via an internet portal. For this study, teachers used a free Google Doc forum for students to read prior knowledge questions. Questions are designed to stimulate student prior knowledge and prepare them for the subsequent web-based instructional video. Prior knowledge is a critical aspect for adolescent learning since it allows them to connect what they are trying to learn with what they already know, understand, or have personally experienced (Jackson & Davis, 2000). Therefore, teacher-provided questions are

designed to use terms and concepts students have prior knowledge of, thus providing an adequate contextual foundation for interpretation of the impending lesson (Liu, Lin & Paas, 2014).

Next, students view a web-based instructional video or narrated screencast. For this study, students and teachers used a free web-based resource known as YouTube due to the user-friendly capabilities. Many students and teachers in this study were already familiar with accessing and manipulating its content. Online videos for this study were generally 10 to 15 minutes in duration. This may appear inadequate but without students present during the lesson, class disruptions such as fire and tornado drills, office intercom interruptions, off-task student behavior, and teacher redirects are absent so lecture time is maximized. Additionally, videos lasting more than 15 minutes may not keep the attention span of adolescents. Bester & Brand (2013) finding suggests the average length of time a high school student can concentrate during lectures was 8 to 14 minutes. Thus, teachers participating in this study were trained to keep video times below 15 minutes. Additionally, a positive feature of online lessons is that students can rewind, fast-forward, and pause as needed so they may absorb the lesson at their own unique pace. This feature of flipped learning is difficult to replicate in traditional lecture classrooms with assorted learning styles and capacities.

Lastly, after students study one or two prior knowledge questions and view the web-based Algebra I instructional video via YouTube, they post remaining relevant questions on the teacher provided online internet forum. For this study, teachers and students used a Google Doc forum. Students were told to post narrowly defined questions about a specific concept they struggled to grasp. Teachers emphasized to their students that questions should demonstrate completed prior knowledge questions, earnestly viewed and attempted to understand the web-based instructional video, and posted relevant questions the teacher used to guide subsequent

classroom sessions. Student online questions ought to guide successive lessons and reduce the time in class that may be consumed re-teaching or revisiting concepts students already mastered.

The target district's objective was to transform in-class time into a workshop where students can ask for clarification about online video content, test their skills in practical applications, network with other students in hands-on activities, and complete assigned mathematics problems collaboratively with teacher guided support. Modified flipped class sessions are designed to switch teachers into guides or coaches that encourage student inquiry and collaborative endeavors as opposed to traditional lectures that may not be effective for some students. Furthermore, in-class time would not be used for teaching a lesson then assigning students outside work absent of teacher support. This aspect of modified flipped methodology reduces the time students spend at home possibly puzzling over mathematics problems and consequently may not complete (Bell, 2015). Lastly, this practice is repeated for each new lesson introduced, with the expectation of maximizing student learning and increasing student outcomes.

The additional components added to the modified flipped platform do not guarantee student participation in out-of-class activities. Students may still not view the YouTube instructional video or casually view it yielding symbolic participation with the program. Learners may fail to post any questions on the internet forum or post questions that lack substance. As a result, this study includes teacher responses gathered via interviews regarding fidelity to the program. All four teachers who participated in either a lecture or modified flipped classroom were asked open-ended questions regarding their activities and perceptions of teacher and student participation in the program. Questions were used to assess teacher perception of their fidelity to the program and teacher perception of student fidelity to the program.

Since the term “fidelity” is discussed throughout this study, it is important to define it. Mellard & Johnson (2007) defines fidelity as the level a program is implemented as intended by developers in addition to the quality of implementation. In order for a school program to have fidelity, it must have integrity, consistency, and accuracy (Pierangelo & Giuliani, 2007). Fidelity ensures lines of open communication and dynamic feedback by providing teachers and school leaders with opportunities to discover and collaborate (O’Donnell, 2008). A school initiative that operates with fidelity should consistently engage the student in the specific activity (Durlak & DuPre, 2008); clearly define the activity or intervention (Harn, Parisi & Stoolmiller, 2013); provide adherence and some degree of longevity to the program (Walker, Seeley, Small, Severson, Graham, Feil & Forness, 2009); provide the student with consistent exposure and longevity to the activity or intervention (Gearing, El-Bassel, Ghesquiere, Baldwin, Gillies & Ngeow, 2011); and have an assured degree of quality associated with the delivery (Hulleman & Cordray, 2009).

A program such as modified flipped learning should reassure that instruction has been implemented as planned while connecting student outcomes to the teaching practice. Furthermore, this aids in determining if the treatment effectiveness and instructional decision making are successful (Bianco, 2010). Fidelity to the program is critical since research suggests that successful student outcomes hinge on how well interventions are supported by evidence (Benner, Nelson, Stage & Ralston, 2011). Therefore, modified flipped learning fidelity of implementation at the school and classroom level must be followed to determine the credibility of the study.

Additionally, fidelity to the program cannot occur in a vacuum. Staff must be properly trained on the correct delivery of modified flipped teaching practices and assessment (Hulleman

& Cordray, 2009). Teachers should adhere to appropriate guidelines of teaching and assessment protocols while avoiding additional support or perspectives to students during an assessment. Schools must follow state-sanctioned timelines for assessing students and monitoring their academic progress.

Rationale for Selecting Algebra I

Yearly student assessment, otherwise known as standardized testing, performs a crucial function in current educational settings (Ladson-Billings, 2006). These outcomes are significant forces that determine school and community opinions about the competence of students, teachers, school leaders, and overall quality of their schools (Duckworth, Quinn & Tsukayama, 2012). State standardized test scores are important measures that have been linked with school funding, accreditation, and annual yearly progress (AYP) reports as governed by No Child Left Behind (NCLB) (Hursh, 2005). Furthermore, yearly assessments are key tools used by teachers and policymakers to assess their performance and make appropriate changes (Ladson-Billings, 2006). Educators may use assessment outcomes to monitor their own teaching practices and evaluate their school's performance (Geier, Blumenfeld, Marx, Krajcik, Fishman, Soloway, & Clay-Chambers, 2008). Local and state policymakers' decisions are often driven by school assessment data (Duckworth, Quinn & Tsukayama, 2012). Since school assessment data plays a central role in the current educational environment, standardized test data is used in many schools, districts, and states (Fast, Lewis, Bryant, Bocian, Cardullo, Rettig & Hammond, 2010). Hursh (2005) findings suggest student assessments are pivotal to improvement, increased standards, and educational quality.

According to the Missouri Department of Elementary and Secondary Education (DESE), End-of-Course (EOC) assessments, are completed when a student has received instruction on the

Missouri Learning Standards for an assessment, despite their grade level classification as part of Missouri School Improvement Plan 5 (MSIP 5) requirements. As of the 2014-15 accountability school year, Missouri mandated public schools assess all students in a minimum of four EOC assessments upon graduation. These include Algebra I, English II, American Government, and Biology. There are five additional EOC assessments Missouri schools may administer that can improve their overall AYP report but are not mandatory. These additional assessments include English I, Geometry, Algebra II, American History, and Physical Science. All EOC assessments have been administered online only for the past several years unless the student's Individual Education Plan permits an online exception. These exceptions include Braille, large print test booklet, or paper/pencil format. All Missouri students, including Missouri Options students (an alternative Missouri graduation program), are mandated to participate in EOC assessments identified as "mandatory" (English II, Algebra I, American Government, and Biology) for accountability intentions. However, some groups of students are exempt from mandatory EOC assessments required for school accountability. According to Missouri's DESE, exempt student groups include:

- Students whose IEP team concludes they are eligible for the Missouri Assessment Program-Alternate (otherwise known as MAP-A)
- English as Second Language (ESL) who have been residents in America twelve cumulative months or less at the time of test administration may be exempted from the English I and/or English II assessments.
- Foreign exchange students are not required to participate in EOC assessment. Students may participate at the district's discretion.

- Home schooled students are not required to participate in EOC assessment. Students may participate at the district's discretion.
- Private school students are not required to participate in EOC assessment. Students may participate at the district's discretion.
- Students who already successfully completed the course or similar course in another state. For example, a student successfully completes American Government or civics in a Kansas school district would be exempt from the Missouri American government EOC assessment.

According to DESE, EOC assessments have become a mandatory part of school curriculum and accountability mechanism in Missouri. Over the past several years, the Missouri EOC assessment tool has been built-in to many required core courses and can function as a convenient assessment tool to compare student outcomes based upon teacher or teaching practices. By comparing EOC assessment data between instructional contexts, schools can check for possible statistical significance changes in student outcomes based upon teaching methodology. Consequently, the target school chose the EOC assessment tool to check for possible statistical changes in student outcomes when comparing two different teaching practices, modified flipped and traditional lecture. In addition, they chose Algebra I for the experimental trial of modified flipped versus traditional lecture practices as opposed to the other three mandatory courses (English II, American Government, and Biology) for two fundamental reasons.

First, based upon multiple administrator classroom observations, Algebra I classrooms were found to be heavily teacher-centered when compared to other core classes. School leaders found many Algebra I teachers spending most, if not all, of class time using traditional lecture teaching practices. This generally consisted of teachers working sample mathematicsematics

exercises on their SMART board while students took notes. Students completed some or most of the assigned homework outside of class without supervised teacher feedback. Houston & Lin (2012) findings imply when instructors center on traditional lecture methodology, students have limited time for questions due to time constraints dictated by the impending lecture. However, modified flipped practices permit pre-packaged instructional materials to be distributed to students via web-based YouTube videos before class. This teaching practice opens up in-class time for opportunities such as higher-order supervised learning and improved collaborative problem-solving skills (Day & Foley, 2006). Additionally, Bernard, Borokhovski, Schmid, Tamim & Abrami (2014) findings suggest team-oriented learning may increase in modified flipped contexts. Ideally, students are more prepared upon arrival to class since they already, in theory, viewed and understand at least part of the lesson.

Critics may argue this same task can be accomplished by students reading a textbook before class. Demetry (2010) findings suggest millennial's are more likely to participate and engage in learning via interactive web-based lessons which are frequent in flipped learning compared to traditional textbook reading. Since students are more likely to participate in the outside lesson before class, the instructor can briefly review lesson fundamentals and assist with student questions. Students can collaborate and interact while the teacher circulates around assisting students at their personal level (Horn, 2013). Flipped learning creates an environment in which the teacher can adapt to many learning styles common in classrooms (Day & Foley, 2006). Thus, the teacher role is transformed from the owner of the lesson to the catalyst of a student-centered learning environment (Houston & Lin, 2012).

The second reason the target district chose Algebra I for the experimental trial was the mathematics achievement gap that exists between whites and nonwhites. The rapidly shifting

racial and ethnic make-up in the United States has created a challenge for schools to educate an ever-increasing diverse student population (David, 2014). Since the Coleman Report in the 1960s brought awareness to racial injustice in learner outcomes, the academic achievement gap between whites and nonwhites has raised significant concerns and produced a considerable amount of empirical research (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld & York, 1966). The achievement gap between student groups is thought to have lifelong unintended consequences such as reduced prospects for nonwhite students in higher education, limited job opportunities, and reduced earning potential (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld & York, 1966).

Moreover, the National Assessment of Education Progress (NAEP) test, which is seen as the country's report card on student achievement in core subjects, found student achievement in mathematics improved only a small to moderate amount from 1973-1999 (Campbell, Hombo & Mazzeo, 2000) and from 2002-2009 there was only a slight narrowing of the mathematics academic gap with eighth graders suggesting additional interventions are needed (Lee & Reeves, 2012). The NAEP also found substantial differences among various racial groups. During the 1970s and the first half of the 1980s, the NAEP showed considerable academic advances of African-American and Hispanic-American learners and a major reduction of the White-Black and White-Hispanic achievement gaps in mathematics (Campbell, Hombo & Mazzeo, 2000). However, since then this growth has slowed and even showed signs of a retarding during the 1990s and early 2000's (Lee & Reeves, 2012). With documented consequences associated with achievement gaps between whites and nonwhites, alternative teaching practices that may reduce this injustice should be explored.

For some time now, school leaders have given secondary mathematics instructors an expectation of improving outcomes and retention of various ethnic backgrounds (Bush & Karp, 2013). Cohen, Garcia, Apfel & Master (2006) studies indicate that interactive teaching practices, incorporating collaborative daily problem-solving skills with integrated higher-order cognitive skills may improve outcomes of students in secondary mathematics classes while reducing the achievement gap between whites and nonwhites. This attitude is undergirded by other educational studies that conclude interactive student-centered teaching practices, such as flipped learning, may reduce the mathematics achievement gap between whites and nonwhites (Marcey & Brint, 2013).

Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt & Wenderoth (2014) findings suggest nonwhite students reported greater engagement in quality interactive educational events compared to their white counterparts. Han, Capraro & Capraro, (2015) found that African-American secondary students reported mathematics gains that were greater than whites as a result of the additional effort placed into interactive class assignments that involved computer technology and web-based interactions. A study by Kizilcec & Halawa (2015) found secondary nonwhites were more likely than whites to have an engagement at above average levels with mathematics lessons that introduced interactive student-centered teaching practices. Research by Ajai & Imoko (2015) also suggests that greater student engagement in mathematics classes may be especially important to the success of nonwhite secondary students. Lee & Reeves (2012) found that nonwhite secondary student achieved and persisted at higher levels than their white counterparts as their engagement increased via technology and web-based usage. Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt & Wenderoth (2014) attribute greater nonwhite

mathematics gains to increased academic-related efforts associated with out-of-class computer and web-based participation.

Similar to other high minority districts in the United States, Westside High School in Macon, Georgia was experiencing decreasing test scores in secondary mathematics courses (Bergmann & Sams, 2012). With over 85 percent minority population and 78 percent eligible for free/reduced lunches they were searching for a solution to reduce the achievement gap in mathematics (Irvin, 2013). With the assistance of a federal grant, the school received the necessary funding to provide each student with a new laptop. Several teachers decided to implement flipped teaching practices with hopes of improving student engagement and student outcomes. After only one year, half of their mathematics teachers saw Algebra I and Geometry state-end-of-exam scores improve by more than 25 percent and a modest increase in their students' final mathematics grades (Irvin, 2013). Additionally, the semester before implementing flipped teaching practices about 30 percent of all students passed Algebra I or geometry. In the first semester with flipped practices, almost three-quarters passed their mathematics class, including nine of ten special education learners (Bergmann & Sams, 2012).

After the recession of 2009, the Byron School District, located outside of Rochester, Minnesota was driven by a new set of challenges that led to an unexpected adoption of flipped practices (Fulton, 2012). When the time came to purchase new textbooks since the current ones did not match new state mathematics standards, the district lacked the necessary funding. District and school leaders had to consider new options. Administrators decided to eliminate mathematics textbooks and create their own textbook-free mathematics curriculum. Teachers created web-based videos for mathematics presentations and students viewed them on their personal home computers if applicable, library computers after school, or their local library

computers. The results of flipping their mathematics courses were significant.

In Algebra II, Byron produced a 5 percent increase in median test scores after flipping their classes (Fulton, 2012). Algebra I and geometry produced similar increases in student outcomes. Student mathematics scores on standardized state exams also rose significantly. In 2006, Byron's secondary mathematics mastery level was 29.9 percent on the Minnesota Comprehensive Assessment (MCA) (Espin, Wallace, Campbell, Lembke, Long & Ticha, 2008). By 2010, Byron's mastery rate rose to 65.6 percent after implementing flipped teaching practices that aligned curriculum with state standards. With a commitment to continued growth, the mathematics department implemented flipped practices in the 2010–11 school year. After one year, the change resulted in nearly 35 percent overall growth with nonwhites producing the greatest growth on the MCAs in 2011 (Fulton, 2012). Byron has continued their commitment to a quality mathematics education for all students, as demonstrated by the fact that at the end of the 2011–12 school year, 94.7 percent of Byron's seniors completed four mathematics credits (Fulton, 2012).

There are also relatively few empirical studies that explicitly compare flipped classrooms to traditional lecture outcomes. For example, there are studies demonstrating flipped learners out-perform their lecture counterparts in biology courses (Marcey & Brint, 2013), statistic courses (Day & Foley, 2006), and a geometry courses (Tune, Sturek, & Basile, 2013). Findings usually suggest improved outcomes are linked to flipped contexts providing more efficient and self-directed interaction with the content (Snodin, 2013; Yang, 2012), increased student collaboration in the classroom (Bernard, 2014; Johnson & Johnson, 2009), and improved quality and proficiency learners have when interacting with the instructor (Vaughan, 2007).

Due to empirical studies in the current literature that suggests mathematics achievement gaps between whites and non-whites may be reduced by flipped learning practices, the target school chose Algebra I to experiment if they could produce similar results. Additionally, they chose to enhance the flipped methodology by incorporating two extra student requirements that may improve student engagement discussed earlier. First, students read prior knowledge questions before watching web-based instructional videos. Secondly, after viewing the instructional video, students post remaining questions on a Google Doc forum the teacher uses to guide subsequent class lessons. Finally, in-class time is used by the teacher to clarify any lingering questions or concepts and allow student collaboration time on assigned mathematics problems while providing guided support. These modifications were introduced to help improve student engagement and participation. This teaching practice was labeled modified flipped and implemented during the 2013-14 school year. Therefore, the target school selected a student-centered teaching practice, modified flipped, with hopes of improving Algebra I outcomes while reducing the mathematics achievement gap between whites and non-whites.

Research Questions:

This study focused on three fundamental research questions:

- 1) How do teacher practices, methods, and student classroom experiences in modified flipped classrooms compare to the traditional lecture classroom?
- 2) How do student outcomes, as measured by Missouri End of Course (EOC) exam scores, compare in the two types of classes?
- 3) To what extent are there differences between teacher's student outcomes, as measured by the EOC, in modified flipped compared to the same teacher's student outcomes in the traditional lecture class?

Teacher interview responses describing instructional practices and student experiences along with Algebra I EOC assessment scores provided data for this study.

The first research question examined how teacher practices, methods, and student classroom experiences were different in modified flipped classrooms versus the traditional lecture classroom. Four Algebra I teachers participated in this study. Their instructional practices, procedures, daily class rituals, and corresponding student responses in traditional lecture and modified flipped contexts were explored. Furthermore, an examination of teacher interview responses described their activities during class, teaching methodologies, teacher perception about student participation during in-class and out-of-class activities, possible changes in student academic behavior along with preparedness, and overall fidelity to the program. Teacher responses illustrated the typical range of teaching practices used in lecture and modified flipped. Data collected described teacher talk time, small group collaboration, in-class time solving mathematics problems, and classroom arrangement. Interview responses were collected using a password protected electronic audio recording device, then transcribed onto paper and analyzed qualitatively to determine teacher and student fidelity to the program. Four teacher interviews ranging from 30–90 minutes were conducted during the fall of 2017 at each teacher's home or place of employment.

The second research question checked for statistical differences in student outcomes as measured by Algebra I EOC exam scores between traditional lecture and modified flipped context. Data was used to measure whether instructional methodologies, more specifically that use one-to-one modified flipped methodology, had any significant difference on student standardized test scores in high school freshman Algebra I classrooms. Several independent sample t-tests checked for significant differences. The dependent variable was students EOC

scores while the teaching methodology employed acted as the independent variable. Additional independent sample t-tests measured statistical difference for EOC scores among minority students, students with Individual Education Plans, and students eligible for free/reduced lunch in the lecture class compared with modified flipped.

The third research question examined if there were any differences between teacher's student outcomes in modified flipped compared to the same teacher's student outcomes in the traditional lecture classes. Each teacher who taught a modified flipped or traditional lecture classroom had their students mean EOC scores for 2013-14 school year compared to their students mean EOC scores from the 2012-2103 school year using independent sample t-tests. Descriptive statistics tables will accompany independent sample t-tests for additional analysis. This comparison provided further findings or limitations regarding the effectiveness of modified flipped learning and possible teacher influences on EOC scores.

Chapter Two: Literature Review

Introduction to Literature Review

Societal changes have accelerated rapidly since the beginning of the twentieth century and technology has been the focus of swift transformation (Hughes, Luo, Kwo & Loyd, 2008). Music companies have struggled with teenagers who download digital songs across peer-to-peer networks (Sun, 2016). Mobile devices, with their ability to receive e-mail, send text messages, and take digital photos have surpassed in number compared to traditional landline telephones (Altintas, Gunes & Sayan, 2016). Even our international enemies have used satellite phones and the Internet to communicate from the farthest parts of the planet (Gilboy, Heinerichs & Pazzaglia, 2015). These rapid technological advancements have revolutionized personal communication and transformed how human interactions arise.

Technology continues to augment changes in many aspects of modern society (Roehl, Reddy & Shannon, 2013). America has undergone a rapid shift from an industrial society focused on mass production and manufacturing efficiency to a new knowledge-based society rampant with solid-state devices that perpetually manipulate algorithms overflowing with information (Furrer, C., & Skinner, E. 2003). Needless to say, the world of education has not been exempt from these changes. Recent advances in technology coupled with decreasing costs and improved availability have opened new avenues for education (Strayer, 2012). As a result, some school leaders are having discussions regarding teaching methods that capitalize on technology in the classroom and possible ways to harness its potential power to improve student engagement and outcomes (Flumerfelt & Green, 2013). Flipped learning is one of the teaching practices at the core of this discussion (Muijs, Kyriakides, Creemers, Timperle & Earl, 2014).

Flipped teaching practices are a relatively new pedagogical teaching method. This teaching practice flips, or inverts, the in-class lecture and outside homework. Students view a

web-based teacher-created instructional video outside of the traditional school day and use in-class time to ask questions and work on assigned problems using collaborative learning methods. Modified flipped learning utilizes prior knowledge questions, asynchronous web-based video lectures, and follow-up student dictated teacher in-class instruction as instructional tools. If implemented with fidelity, students routinely engage in outside classroom activities utilizing active learning and teacher guided problem-solving web-based activities that enhance the learning process. However, it would be a mistake to interpret modified flipped learning as merely flipping the lecture and homework locations. Advocates of modified flipped learning argue it is more complex than re-arranging typical classroom activities. Rather, modified flipped learning represents an expansion of the curriculum that is grounded in a distinctive combination of learning theories.

Critics of flipped learning argue this methodology has been around for years but with a different delivery mechanism (Westermann, 2014). It is a teaching practice that generated significant disapproval from some who argue that flipping is basically a high-tech adaptation of an instructional method known as lecturing (Driscoll III & Petty, 2017). The main concern is that teachers still rely on lecture as the principal delivery system of communicating instructional content (Nouri, 2016). Triantafyllou & Timcenko (2015) findings suggest that lecture is not how all students learn, and flipping does not do anything different to transfer the nature of learning that occurs (Westermann, 2014). Ahmed (2016) findings suggest that educators initially believed that flipped learning was a modern method to instruct since much of the assigned work can be completed in class with peer-to-peer or adult assistance increasing engagement since students generally do not always complete outside problems. Upon closer inspection, critics

argue flipped learning is merely a time-shifting apparatus grounded in similar didactic, lecture-based concepts (Nouri, 2016).

Detractors argue this same teaching practice has been around for decades when teachers instruct their students to read a lesson in the textbook before class (Nouri, 2016). Flipped learning opponents argue this teaching practice is very similar to flipped learning with the exception that lessons are provided by a teacher via a web-based video (O'Flaherty & Phillips, 2015). Additionally, challengers of flipped learning argue the invention of the Video Cassette Recorder (VCR) and camcorder during the 1980's is very similar to current flipped learning practice and delivery systems (Cresap, 2015). Teachers would record their lessons using a camcorder and cassette tape. Students would retrieve the cassette tape, usually from the school library, and view it at a remote location on VCR technology then return the cassette tape. This teaching practice is very similar to flipped learning with the exception of the distribution and availability of the instructional content. Consequently, critics of flipped learning argue teaching practices very similar to flipped methodology have been common for decades in education and remote access to teacher lectures is nothing innovative (Cresap, 2015). Nonetheless, flipped learning supporters believe it has relevant theoretical backing that improves student engagement and outcomes when compared to lecture methods (Choi & Lee, 2018).

The theoretical underpinnings used for justifying flipped methodology normally centers on reasons for not using in-class time to convey lectures. These are rooted in a body of literature on constructivist and student-centered learning, which mostly focus on the theories of Piaget, Vygotsky, and Dewey (Cole & Wertsch, 1996).

First, active learning activities founded upon constructivist theory occur outside of the traditional classroom. Active learning is an umbrella term for pedagogies centered on student

activity and engagement in the learning process (Prince, 2004). In modified flipped contexts, these include reading prior knowledge questions, viewing web-based instructional videos, thinking about and posting relevant lingering questions to a classroom web-based forum the teacher utilizes to facilitate subsequent in-class lessons while offering guided support.

Secondly, central elements of collaborative learning activities are derived from direct instructional methods founded upon collaborative learning principles which typically occur in the classroom. These principles are buttressed by Piaget's theory of assimilation and accommodation which viewed learning as hands-on, and Vygotsky's theories of social interaction and appropriation as key components in the learning process (Powell & Kalina, 2009). John Dewey also made several significant contributions to numerous aspects in education and philosophy; however, this study will focus on his analysis of student-centered activities such as collaboration in the learning process (Saltmarsh, 2008).

In the modified flipped context, this generally occurs in the second half of class time when students engage in collaborative learning with guided support by the teacher. Students collaborate on in-class assigned problems in groups of two or three in which learning emphasis is dictated by peer social interactions as opposed to solitary activity. This aspect was part of the target school objective with modified flipped implementation. Their aim was capitalizing on the benefits of collaborative learning by making it a daily ritual in Algebra I classes. The daily peer-to-peer collaboration with adult assistance was implemented with the hopes of improving student outcomes. Consequently, fidelity to the program was also critical. Without fidelity regarding consistent collaboration, a central foundational component of flipped learning would be absent and possible benefits of it may not be satisfied.

Constructivist Theory

The first central learning theory supporting modified flipped practices is constructivist theory. For several decades, educational researchers have become increasingly skeptical of the effectiveness of teaching practices centered on lecture formats (Findlay-Thompson & Mombourquette, 2014). In spite of wide-spread improvements and affordability in computer technology coupled with assorted techniques for pedagogy, lecture formats continue to be a popular methodology for packaging and delivering instruction (Morgan, 2014). Traditional lecture has been used for so long the casual classroom observer may expect to see students taking notes and listening while receiving instructions from a teacher (Berrett, 2012). Marks (2000) published a study after literally observing thousands of American classrooms and noted that by far the most pervasive method for class instruction was “teacher talk” or lecture. He found that teachers seldom encouraged peer-to-peer dialogue, interaction, or other activities that provide student opportunities to collaborate in small groups. Lundeberg & Yada (2006) findings imply that lecture primary emphasis was on rote memorization and fact recall instead of student inquiry or investigation (Lundeberg & Yadav, 2006). O’Conner (2013) findings suggest teachers using lecture practices may have less emphasis on student planning, goal setting, mastering goals, and alternative methods for achieving goals. An unintended consequence of one-sided lecture methodology may be limited student experience with collection, evaluation, synthesis, collaboration, or assessing data (Jones, 2007). McGarr (2009) findings put forward that students may struggle to learn critical life skills such as analyzing the logic behind questions and problems or altering their thinking for possible solutions when only exposed to lecture. Smith (1997) results suggest if this continues as the dominant practice, traditional lecture may promote a school culture that limits students who can effectively think for themselves.

Eberlein, Kampmeier, Minderhout, Moog, Platt, Varma-Nelson & White (2008) findings imply education researchers and educators are increasingly aware of the complexities of teaching and learning for understanding compared with fact recall that may result in limited knowledge depth. O'Flaherty & Phillips (2015) results suggest if the objective of teaching is to encourage a deeper understanding, school leaders and educators may consider limiting rote memorization and focus more on an intimate learning process in which understanding manifests through active and constructive processes. To accomplish this goal, educators may consider changing from a teacher-centered model toward a student-centered model. Henson (2003) findings recommended some fundamental principles as optimal techniques for promoting active student learning. These are defined as instructional activities in which students do things and think about what they are doing (Phillips & Trainor, 2014). Prince (2004) findings imply student activities should deliberately emphasize essential learning outcomes necessitating genuine participation and engagement.

Prince (2004) results broadly defined active learning as any instructional practice that engages students in the learning process. Prince contrasted active learning with traditional lecture in which students might passively receive information. According to Prince's (2004) definition, active learning is broad enough to include many traditional classroom activities, including traditional lecture practices assuming students are note taking, reflecting, or asking questions. Nonetheless, in an attempt to distinguish between teacher-centered and student-centered practices for this study, teacher-centered methodologies are dismissed to promote active learning. For example, active learning in this study includes students reading and thinking about prior knowledge questions, actively viewing asynchronous instructional videos, and posting relevant remaining questions via a teacher provided Google Doc forum. As mentioned earlier,

student fidelity to these characteristics of modified flipped practices is foundational for possible impacts on student outcomes.

Furthermore, Prince (2004) suggested active learning mutually included peer-assisted and problem-based learning methods. He also described the association between these two methods, indicating that problem-based learning is nearly always active and frequently, but not always, collaborative. The significance of student-centered learning theories in flipped contexts should not be downplayed. Without these components, flipped learning cannot function.

Flipped learning methods require two fundamental components to operate with fidelity: one component requiring teacher and student interaction usually via in-class activities and a second automated component usually through an out-of-class computer or web-based assistance such as web-based instructional video lectures (Miller, 2012). The classroom component is vital, and the student-centered learning theories provide the philosophical foundation for the blueprint of these activities. However, critics may dismiss this reality and define flipped learning based entirely on the existence or absence of a computer and web-based activities such as instructional videos. This conclusion would be misguided since the pedagogical theory used to arrange in-class activities may be the critical feature dictating the success or collapse of flipped learning.

In addition to Prince's contribution on active learning, Zayapragassarazan & Kumar (2012) found three broad instructional method categories that encourage active learning in classrooms: (a) individual activities, (b) paired activities, and (c) informal small groups. Modified flipped practices, when used with fidelity, require individual student activity via out-of-class assignments such as viewing instructional videos while utilizing the appropriate supporting materials. It also encourages student engagement in paired and informal small group activities during in-class peer-assisted learning that will be explored in more detail later. These

methods may include various student activities such as brainstorming, abstract mapping, collaborative writing, case-based instruction, collaborative learning, role-playing, mock-ups, project-based learning, and peer-assisted learning (Zayapragassarazan & Kumar, 2012). Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt & Wenderoth (2014) findings suggest active learning methods may encourage students to exploit higher-order thinking abilities such as analysis, synthesis, and assessment. Active learning models may generate a more comprehensive approach to instruction that engages students with diverse learning capacities and styles. Roberts (2016) findings imply these pedagogies are more likely to appeal to the classic millennial or Generation Z who may prefer a setting of change and diversity.

Modified flipped learning, as defined in this study, may promote active learning. First, outside classroom activities provide students the opportunity for active learning. Students are expected to view and think about a few prior knowledge questions the teacher provides on a web-based Google Doc forum. Examples of prior knowledge questions may include students preparing for a lesson on polynomials by reviewing how to manipulate integers or evaluating various roots. A lesson on calculating cubic feet of a cube may involve prior knowledge questions centered on calculating the area of a square. Or a lesson on graphing curves may involve prior knowledge questions on graphing lines. Questions are designed to stimulate student prior knowledge and prepare them for the subsequent web-based instructional video. Prior knowledge questions are a critical aspect for active learning since they allow students to connect what they are trying to learn with what they already know, understand, or have personally experienced (Jackson & Davis, 2000). Thus, teacher-provided questions use terms and concepts students should have a basic understanding while providing an adequate contextual foundation for interpretation of future lessons.

Secondly, after reading and thinking about prior knowledge questions, students view a web-based instructional video approximately 15 minutes in length. Active learning is encouraged with the instructional video since students are supposed to think about the content. The online format permits students to rewind, fast-forward, and pause as needed so they can absorb the lesson at their own unique pace. This aspect is virtually impossible to replicate in traditional lecture settings.

The third step for outside activities in modified flipped learning is students posting genuine questions on a web-based Google Doc forum. Questions should be narrowly defined about a specific concept they are struggling to grasp. Teachers use these questions to guide subsequent classroom sessions. As stated earlier by Prince (2004), active learning should deliberately emphasize essential learning outcomes requiring genuine student participation and engagement. If students utilize out-of-class modified flipped learning as intended, active learning is designed to be pervasive with this teaching practice which may lead to improved student outcomes.

Collaborative Learning Theories

The second theory supporting modified flipped learning is collaborative learning principles. These typically occurred in the second half of class when students engage in peer-assisted learning activities. Collaborative learning is the attainment of information and skill development via active helping and support between ranks that are identical or matched companions (Roberts, 2016). Foot & Howe (1998) findings suggest that collaborative learning and peer tutoring underpin nearly all peer-assisted learning methods in education practice. Li & Lam (2013) went on to explain that collaborative learning embodies nearly all the meticulous structures of the paired learning spectrum.

Collaborative learning usually occurs directly after the teacher utilized the Google Doc forum responses to answer remaining questions students have about the previously viewed instructional video content. Students are typically paired in groups of two or possibly three and complete assigned problems using collaborative learning. Piaget research theories into appropriation and Vygotsky's research theories of social interactions are core fundamental concepts that provide the groundwork to support the effectiveness of collaborative learning in modified flipped learning.

Appropriation of knowledge is a method of constructing information from social and cultural foundations and assimilating it into pre-existing cognitive structures or mental schemas. According to Piaget, cognitive structures or mental schemas were mental images produced in response to a stimulus that becomes a framework or basis for analyzing or responding to other related stimuli in children (Wavering, 2011). It is a developmental process that forms through social preparation and typically consists of goal-oriented actions (Van Merriënboer & Sweller, 2005). It is based on the learning developmental theories of Piaget and Vygotsky that entail the cognitive developmental and social-constructivist components of learning.

The concept of appropriation was used by Vygotsky during the time frame of industrialization mainly throughout the early part of the 20th century (Wertsch, 1979). At that time period, conditioning models were common and widespread. During the social and cultural periods of the 1920's and 1930's, Vygotsky's traits of human growth were a comparison to a development similar to the influential conditioning of reflexes for mastering a task (Vygotsky, 1978). Vygotsky believed elevated psychological thinking was a result of physical or social relationships between humans and their environment (Kirch, 2014). Modern-day terminology would most likely place elevated psychological thinking in cultural or meaning-making contexts

(Rubtsova & Daniels, 2016). Vygotsky (1978) believed social interactions, like talking, were a transformation of practical activities. By way of these transformational processes, students can learn to appropriate detailed action mechanisms in various contexts (Powell & Kalina, 2009). According to Vygotsky, this was a scientific process. The fundamental progression was an external activity that is reconstructed and starts to emerge internally (Nordlof, 2014). A social situation occurring externally is internalized by the individual. In other words, an interpersonal process is changed into an intrapersonal process (Wertsch, 1979). Vygotsky believed this process of internalization hinged on the individual's developmental stage. He described the interpersonal process into an intrapersonal process as a function of lengthy sequences of developmental actions and summarized it as culturally depended (Powell & Kalina, 2009). According to Vygotsky (1978), cultural forms of behavior internalization entail the restoration of psychological actions on the foundation of sign operation.

Computer technologies such as laptops, and more recently mobile devices, have become common in everyday life (Abeysekera & Dawson, 2015). Their context is generally centered on “user” instead of other motivations or orientations such as meaning-making or learning (Kirch, 2014). Broadly speaking, in teaching contexts, meaning-making is defined as the theoretical and practical link between the everyday usage of computer technologies and learning as “understanding or coming to know” (Jensen, Kummer & Godoy, 2015). In this study, implementing the three fundamental components of flipped learning coupled with in-class collaboration may promote student connections between theoretical aspects in Algebra I and the “understanding or coming to know” allowing students to “make meaning” of the lesson. As stated earlier, critics argue this is no different than assigning students a chapter to read before class. However, Roehl, A., Reddy, S. L., & Shannon, G. J. (2013) findings suggest that

millennials and their younger peers raised on technology are much more likely to view out-of-class pre-packaged web-based instructional videos than read a textbook chapter before class. If implemented with fidelity, modified flipped learning may impact student outcomes. Thus, computer technologies such as laptops, tablets, or mobile devices may operate as possible learning tools within the cultural applications in school settings using the previous definition of learning.

However, Abeysekera & Dawson (2015) findings imply educational institutions are showing skepticism toward adopting technology in classrooms as learning tools. This is understandable since some experienced school leaders and teachers have seen several education fads and reforms abandoned over their careers and hesitate to embrace laptops as learning tools (Cestari, 2014). Still, educators may want to reconsider technology in the classroom.

In addition, learning as a method of meaning-making via adult and peer interaction originates on the foundations of current and objective cultural world identified by swiftly changing socio-cultural and technology devices capable of mass communication (Li & Lam, 2013). This combination of activities within these structures forms the appropriation of the technology complex and its various mechanisms (Yang & Huang, 2015). One of the most visible structures is the influx of laptops and their availability. Using formal curriculum in education, appropriation permits students to conceptualize the bridge between casual meaning-making and objective knowledge (Levrini, Fantini, Tasquier, Pecori & Levin, 2015).

In addition to appropriation, Swiss biologist and psychologist Jean Piaget's had other theories of learning. His theory of cognitive development and collaborative learning postulate that students must continuously adapt to their learning environment (Mainemelis, Boyatzis & Kolb, 2002). He undergirded his cognitive developmental learning theory in the individual

learner and described children as active, intelligent, creative constructors of their own knowledge structures (Li & Lam, 2013). Piaget described two methods for adaptation which is an individual's ability to blend in with its surrounding environment. Piaget labeled these two methods assimilation and accommodation (Mensah & Somuah, 2014).

Assimilation is the process of manipulating or changing the environment so it can be positioned in a pre-existing cognitive structure or schema. Accommodation is the process of shifting cognitive structures or schemas to accept something unusual or different from the environment. The individual has the capacity to modify these mental schemas and augment their efficiency (Wavering, 2011).

Piaget theorized, the cognitive developmental ideal state is a steadiness between assimilation and accommodation, which he dubbed equilibrium. Piaget believed when a balance between an individual's mental schemas and the external world has been obtained, students are in a relaxed state of equilibrium (Seel, 2012). Consequently, students have mastered the instructional content and possess the certainty in their talent to execute the given task. At this time, students are not in a state of learning new content and have reached equilibrium. Conversely, disequilibrium occurs when students encounter new environmental phenomena. The new environmental phenomena usually do not fit precisely into the student's current mental schemas. Piaget believed students naturally gravitate toward disequilibrium due to their natural curiosity about the surrounding world. Thus, disequilibrium created via exposure to new instructional content encourages student learning as it fosters changes to students mental schema.

Piaget's research and theories on cognitive development contributed to the foundational underpinnings of collaborative learning. Piaget theorized that every experience and interaction between students has an impact on cognitive development in early childhood and these

experiences collectively contribute a vital and active role in student growth of intelligence (Wavering, 2011). Furthermore, he concluded students learn through doing and actively exploring, which are believed to be key components to successful modified flipped learning (Seel, 2012). Piaget's research suggests that childhood interaction with other students establishes cognitive structures or mental schemas (Nakagaki, 2011).

Vygotsky's principles of social interaction also play a key role in student learning as well. He theorized it was via social interaction that students can learn from each other and adults (Vygotsky, 1980). In Vygotsky's social constructivism, social interaction is a significant means in which students discover knowledge available in their culture without necessarily reinventing it (Roberts, 2016). Adults and peers participate in critical roles during the process of appropriation in student knowledge. During class, teachers provide guided instruction and feedback to students. It should be noted this is not a passive process since students respond to teachers and convey their questions or answers in an interactive style (Wavering, 2011). During in-class collaboration, students may engage with peers or adults during problem analysis. By engaging in meaningful collaborative activities, students interact with peers and more knowledgeable individuals. This peer interaction is the catalysts for learners to develop conversations within the confines of activities. Throughout this exchange of ideas and information, students generate and develop an increased understanding and depth of knowledge regarding the content (Mensah & Somuah, 2014). As a result, student learning and cognitive development emerge.

Furthermore, O'Donnell & King (2014) stated that Vygotsky's social interaction theory implies that students learn initially through peer-to-peer interactions and then individually through an internalization process directing them into a more intimate understanding of the content. Vygotsky describes three different categories of speech in the social learning process:

social, private, and inner. He defines social speech in a classroom setting as instruction the teacher disseminates to students and private speech that permits students to process adult instructions and exercise it in applicable settings. For example, the teacher may inform the class to slide next to their mathematics partner and solve an Algebra problem in their textbook. Students must use mathematics logic to execute an algorithm to solve a problem. Thus, private speech is utilized as students are using it to “regulate their actions” (Vygotsky, 1967). Since the teacher notified the class to solve a mathematics problem with their partner, they should collaborate to accomplish the task. It should be noted that in this example both parties are responsible for cultivating student private speech. Furthermore, the internal student speech occurs as their silent and abbreviated internal dialogue is maintained within themselves. This dialogue is the fundamental nature of conscious and mental activity (Vygotsky, 1978). In the above example, students must internalize the rewards and unintended consequences of completing or not completing the mathematics problem. Rewards may include being adequately prepared for the test or receiving participation points for the day. Unintended consequences could mean reduced or no participation points for the day or inadequately prepared for the test. Student thoughts are the result of social speech becoming private speech that has been internalized by the individual (Hogan, & Tudge, 1999). Once cultural signs and meanings become internalized, students obtain the aptitude for higher order thinking and processing (Vygotsky, 1978).

American philosopher and educator John Dewey was a strong believer in collaborative learning. One of his most impactful contributions is the premise that teachers should introduce real-world problems into school curriculum (Ültanir, 2012). However, his thoughts on student-centered collaboration and social constructivism are critical components regarding learning that

is relevant to this study.

Dewey suggested that student reflection occurs with the outcomes of incompatible aspects within an empirical situation. Then opposing reactions are provoked which cannot be taken simultaneously in obvious action (Powell & Kalina, 2009). In other words, cognitive contradictions within student minds act as a catalyst for learning while determining the organization and nature of the subject being learned. This process encourages dialogues between learners in a classroom during collaboration. Dewey implied this method encourages ongoing peer discussions and conscientious listening, making sense of the other student perspectives, and evaluating personal implications to the theories of their peers (Anderson & Dron, 2011). When students share their theories and defend one over another, they select a theory that is more feasible leading to the best theory (Weegar & Pacis, 2012). Dewey summarized the goal in education should be to learn collectively, welcome and exploit distributed knowledge, and express the various types of cognitive processes required for learning (Liu & Ju, 2010). Thus, Dewey was an advocate of collaborative learning, a fundamental mechanism in modified flipped methodology.

Additionally, Dewey's research also suggests learning hinged upon student engagement and knowledge (Ültanir, 2012). These ideas gradually materialize from situations in which students learn when they have experiences that engage and generate importance to them (Powell & Kalina, 2009). Dewey argued human thought is essentially practical problem solving which continues by experimentation (Weegar & Pacis, 2012). He hypothesized this occurs best in a social context in which students collaborate in manipulating materials and examining outcomes (Anderson & Dron, 2011). For example, if two students are given a two-step mathematics problem each student takes one piece and develops the proper solution through engagement.

Next, both join together and by experimentation and sharing or teacher support, they collaborate to solve the mathematics problem. When this is repeated on a daily basis students use their peers and adults to become better problem solvers and more engaged in the learning process which is difficult to achieve if work is completed outside of class.

Dewey's concept of the teacher's role in a social constructivist classroom was not so much focused on traditional lecture but rather acting as a skilled learner who directs students into implementing cognitive approaches such as self-assessing, articulating their understanding, directing inquisitive questions at peers or adults, and thoughtful reflection. Dewey suggested that teachers in constructivist classrooms classify information around central concepts that connect students interest, allow students to collaborate in developing new approaches, and link new ideas with their prior knowledge. Dewey's contributions regarding student experiences through engagement, prior knowledge, and thoughtful reflection through collaboration with peers or adults are used by advocates of flipped learning as part of the mechanism for its success (Bishop & Verleger, 2013).

Chapter Three: Methodology

Introduction:

A total of four teachers were assigned to teach freshman Algebra I during the 2013-14 school year. Teachers A and B were assigned the modified flipped classroom while teachers C and D were assigned the traditional lecture classroom. Teacher A taught six sections of modified flipped classes with approximately 30 students in each section. Teacher B taught one section of class-within-a-class (CWC) special education with 23 students, 11 of whom had Individual Education Plans (IEP) while the remaining were regular education students. Teacher B was the primary teacher who instructed the class while another special education teacher certified in special education and ninth grade mathematics was present and assisted the 11 special education students. Teachers A and B had a total of 197 students who received the modified flipped instructional practice.

Teachers C and D taught the remaining 196 Algebra I students via traditional lecture practices. Teacher C taught six sections of lecture with approximately 30 students in each section while teacher D taught one section of CWC with 22 students, 11 of those had IEP's while the remaining were regular education students. Teacher D was the primary instructor who instructed the class while another special education teacher certified in special education and ninth grade mathematics was present and assisted the 11 special education students.

All four teachers were interviewed and asked questions about the 2013-14 school year in which the Algebra I modified flipped class experiment was conducted. Teachers were asked to describe their perceptions about their teaching practices and perceptions about student participation during in-class and out-of-class activities. Interviews took place during the fall of 2017 in their homes or place of employment and were approximately 30 – 90 minutes in length. Each teacher was read an oral consent form before beginning the interview and given the

opportunity to withdraw at anytime via verbal request. All four teachers completed the interview.

Participants

For this study, there were two groups of participants. The first group of participants were four Algebra I teachers randomly assigned to instruct either the traditional lecture or modified flipped sections. Four of the twelve mathematics teachers at the target site location were randomly selected by the building level administrator and each teacher had at least two years mathematics teaching experience. All four teachers selected were between the ages of 30 and 41 to reduce the possibility of selection bias. Selecting very young tech savvy teachers to instruct the modified flipped classrooms could have skewed student outcomes since young teachers may be more proficient and comfortable with technology and web-based instruction in their lessons. Similarly, experienced teachers who lectured mathematics courses for many years could have skewed student outcomes given that they may be more proficient and comfortable with lecturing. Thus, the building administrator selected teachers with similar technological experiences and relatively small age gaps.

Freshman students were the second group of participants. For this study, freshman students were randomly divided into two groups. Group one received Algebra I instruction via modified flipped methodology taught by teacher A and teacher B. Group two received the Algebra I instruction via traditional lecture taught by teacher C and teacher D. Of the 393 student participants, 21.3 percent were non-white, 22.3 percent were eligible for free/reduced lunches and 5.5 percent had an IEP for mathematics services. For comparison, according to the Department of Elementary and Secondary Education (DESE), Missouri's average nonwhite population during the 2013-14 school year was 26.7 percent with 49.9 percent of students

eligible for free/reduced lunches. In this study, 5.5 percent had an IEP for mathematics services. The 5.5 percent represents students who were identified as having mathematics deficiencies significant enough to warrant additional mathematics services.

To legitimize the study, it was imperative students were randomly assigned either the modified flipped or traditional lecture classroom. This task was already built into the scheduling process the target school used when generating the master schedule. The master schedule and student schedules were generated with *PowerSchool* student information systems. *PowerSchool* is a software program designed to meet administrative needs, such as creating student schedules, tracking attendance, reporting state compliance information, data and faculty management, student health and medical management, and registration.

The process for generating ninth grade student schedules for the 2013-14 school year began in the winter of 2013 at the target district's middle schools. Between January and March of 2013, eighth-grade students selected their courses on a course selection sheet they chose to take as ninth graders for the subsequent school year. Core classes such as Algebra I, English I, American History, and Physical Science were already selected for them, but students did have control over a few electives. It should be noted about 25 teacher-identified eighth graders completed Algebra I as eighth graders and enrolled in Geometry as ninth graders. These 25 students were excluded in this study. Only Algebra I EOC scores were measured for statistical significance.

Once eighth-grade students selected their seven credits worth of courses, school faculty entered student course selection requests into *PowerSchool* student information system. This process is repeated for all tenth thru twelfth graders as well. Once all student course requests along with teacher course assignments and other pertinent scheduling parameters such as the

number of terms, days, and periods have been defined, *PowerSchool* utilizes an algorithm to randomly assign students a schedule. *PowerSchool* software is designed to optimize the number of students with complete schedules based upon each school's unique defined parameters.

For example, *PowerSchool* algorithm may generate 85 percent of students with completed schedules based upon student course request and school defined scheduling boundaries. This indicates that 85 percent of the students have fully completed schedules that match their course requests. The other 15 percent do not have complete schedules. Next, school faculty manually reviews the 15 percent incomplete schedules and makes necessary corrections to provide each student with a complete schedule. This indicates the student did not receive their first course selection and may have an alternative course "hand entered" into their schedule by a staff member so they have a complete schedule. Students always receive their core courses but may receive an alternative fine art, practical art, or elective credit. *PowerSchool* algorithms are designed to optimize the number of completed student schedules based upon student course selections and school defined scheduling parameters. This greatly reduced bias since school staff are not selecting Algebra I teachers or treated versus non-treated group for their students' schedules. Thus, students who participate in the study had their courses assigned by an algorithm designed to optimize complete schedules, not by school staff that may have biased the study for or against technology in the classroom.

Teacher Interview Methods:

It is important to re-enforce that modified flipped methodology required three out-of-class student activities to function as designed and thus undergird subsequent conclusions or limitations regarding student outcomes. These three activities included: students reading and thinking about prior knowledge question(s), earnestly viewing a daily web-based instructional

video, and posting substantive follow-up questions on classroom web-based Google Doc forum the teacher uses to guide future lessons. Some students may not have earnestly viewed the web-based instructional video yielding symbolic participation with the program as designed by the target school. Also, some students may have failed to post any questions on the Google Doc forum or questions that lack substance. Thus, appropriate reporting methods are necessary to provide accurate data. The method used to ascertain teacher and student fidelity to the program was instructor interviews. As a result, all four teachers were interviewed during the fall of 2017.

Teacher interviews were audio recorded on a password protected electronic device that was stored in a secure location and transported in a motor vehicle to and from each subject's residence or place of employment. Interview sessions were approximately 30-90 minutes in duration. Interviews consisted of a series of open-ended questions with appropriate follow-up inquiry designed to support an ongoing conversation and illustrate typical classroom activities during class in modified flipped and traditional lecture context. During interviews, the recording device was under appropriate supervision at all times. Interview data will be stored for approximately one year from December 2017 and destroyed.

Since teachers and students can be fickle and their level of participation may vary from day-to-day over a nine-month interval, teachers were asked open-ended questions about their instructional practices, student in-class activities, and teacher perceptions about student out-of-class activities on an average day. Teacher responses were used to illustrate their average daily activities during class time such as duration of talk time, time spent solving mathematics problems in class, time spent answering questions at the beginning of class, teacher perception about student participation during in-class and out-of-class activities, possible changes in student academic behavior along with preparedness, seating arrangement configurations, and overall

fidelity to the program. Instructor responses helped illustrate the typical range of teaching practices used in lecture and modified flipped contexts. Teacher interview data is reported and analyzed in Chapter Four to ascertain any possible differences in teacher practices, methods, and student classroom experiences in modified flipped versus the traditional lecture settings. Data collected was analyzed qualitatively and used to determine the level of teacher and student compliance to the respective classroom teaching context and participation in all aspects of the methodology. Additionally, descriptions of teacher talk time, student collaboration time, in-class assigned problem completion time, and teacher perceptions about student participation and possible changes in academic preparedness were reported.

Lastly, teacher interviews regarding fidelity to the program were judged by each teacher's perception of their consistency and accuracy when implementing the various aspects of modified flipped or lecture methodology discussed earlier. Fidelity was also judged by all four teachers' perception of student participation in their assigned teaching context. Consistent engagements of student participation in the various aspects of modified flipped learning were monitored by each teacher and their perception reported via interviews. Teaching practices should reassure that instruction has been implemented as planned so outcomes can be connected to the assigned methodology. Findings suggested whether or not treatment methodology impacts outcomes. Furthermore, teachers' adherence to appropriate guidelines of EOC assessment protocols during testing must be accurate for proper conclusions.

The following questions were discussed during teacher interviews and follow-up questions were introduced contingent on teacher responses:

1. How did you begin each class? What percent of the time did you lecture to the whole class? Describe what you did in class on an average day.

2. Describe the typical classroom seating arrangement. Were students in rows, small groups, pods, or another configuration?
3. What percent of the time did you work problems in class? What percent of the time did students do assigned problems in class? What percent of the time did you answer student questions in class?
4. Describe your perceptions of student academic behavior in class (Were students more or less prepared when they came to class?)
5. (For modified flipped only) What percent of the time do you think students did all three components (read prior knowledge questions, earnestly view the videos, post relevant follow-up questions to the Google Doc forum) of the modified flipped classroom? How do you know? Did you have a daily checklist, survey, or log? Was it based on teacher impression of each student? Was encouraging students to consistently do all three components an ongoing problem?
6. (For modified flipped only) After students viewed the online video, how many questions were posted to the Google Doc forum on average each day? What percent of students posted at least one relevant question on an average each day?
7. (For modified flipped only) How much time did you spend on average implementing all three components (creating and posting prior knowledge questions, creating and posting web-based instructional videos, reading and utilizing student Google Doc questions to guide subsequent lessons) of the modified flipped classroom? Describe the instructional video making process? Did teachers take turns creating instructional videos or did the same teacher make all the instructional videos? How much time was spent creating each video on average?

End of Course Exam Methods:

In addition to qualitative analysis of the four teacher interviews who participated in the study, quantitative Algebra I End of Course (EOC) exam scores were an important measuring instrument to confirm possible statistical differences in student outcomes between lecture and modified flipped treatment groups. Algebra I EOC exams were completed by the participating students during a state-sanctioned testing window in late April and early May of 2014. Exam online administration was contracted out to Questar Assessment Corporation and administered during school hours with no time limit on testing sessions. According to DESE, Missouri EOC Algebra I exams measure student performance in five course level expectation strands:

1. Numbers and Operations
2. Algebraic Relationships
3. Geometric and Spatial Relationships
4. Measurement
5. Data and Probability

The target district assigned one building level assistant administrator as the test coordinator to manage all testing logistics and provide school staff with appropriate training that ensured all state-sanctioned EOC testing protocols were obeyed before, during, and after testing. Following testing, each student received an EOC scaled score after completing a valid attempt in any test session. EOC scaled scores range from 100 to 250. Approximately two to three weeks after all students completed their EOC; exam results were mailed and emailed to the target district assigned testing coordinator and distributed to each school testing coordinator. EOC scores were requested via email from the target school testing coordinator during spring 2016. EOC exam data was returned in a spreadsheet format via email by the target school testing coordinator during summer 2016 and disaggregated according to white versus nonwhite,

free/reduced versus non-free/reduced lunch, IEP versus non-IEP, and treatment versus non-treatment group. Additionally, 2012-13 Algebra I EOC scores were included and matched accordingly to teacher A, teacher B, and teacher C for analysis between 2012-13 and 2013-14 school year. Teacher D was not employed in the target district during the 2012-13 school year.

When all testing is complete, Questar Assessment Corporation compiles student answers and points earned to obtain Algebra I EOC scaled scores and convert them into performance ranks. Student outcomes on Algebra I EOC exams are reported in provisions of four performance ranks that express a path to proficiency. These four performance levels from lowest to highest are Below Basic, Basic, Proficient, and Advanced. Each performance rank symbolizes a standard of achievement for every assessed content area. Furthermore, performance ranks depict student capabilities regarding their skill level and content on their assessment. EOC scores are an important method of evaluating student exam results with standards of academic outcomes. According to DESE, for the spring 2014 testing window Algebra I EOC scaled score numeric performance values and interpretations were as follows:

Below Basic: 100 – 187

Students with Below Basic scores on the Algebra I EOC assessment indicate insufficient comprehension of important college and career readiness mathematics content and concepts. Students show evidence of these deficiencies in number and quantity, algebra, functions, statistics, and probability. Additionally, students scoring below basic possess limited mathematics strategies when solving basic problems with incomplete accuracy and fluency.

Basic: 188 – 199

Students performing at the Basic level on the Missouri Algebra I End-of-Course Assessment indicate partial comprehension of important college and career readiness mathematics content and concepts. Students exhibit these skills in number and quantity, algebra, functions, and statistics and probability. In addition to students possessing, comprehending, and applying mathematics skills at the Below Basic level, students scoring at the Basic level executes strategies to solve routine problems with partial accuracy and fluency.

Proficient: 200 – 224

Students performing at the Proficient level on the Missouri Algebra I End-of-Course Assessment indicate adequate comprehension of important college and career readiness mathematics content and concepts. Students exhibit these skills in number and quantity, algebra, functions, and statistics and probability. In addition to students possessing, comprehending, and applying mathematics skills at the Basic level, students scoring at the Proficient level execute strategies to solve problems with adequate accuracy and fluency.

Advanced: 225-250

Students performing at the Advanced level on the Missouri Algebra I End-of-Course Assessment indicate a thorough understanding of important college and career readiness mathematics content and concepts. Students exhibit these skills in number and quantity, algebra, functions, and statistics and probability. In addition to students possessing, comprehending, and applying mathematics skills at the Proficient level, students scoring at the Advanced level executes strategies to solve non-routine problems with a high degree of accuracy and fluency.

For this study, Algebra I EOC scores measure for possible statistical difference using independent sample t-tests with SPSS software. Students with nonwhite status, free/reduced

lunch status, and those with individual education plans were checked for significance using independent sample t-tests. Additionally, each teacher who taught a modified flipped or traditional lecture classroom will have their mean Algebra I EOC scores for 2013-14 school year compared to their mean Algebra I EOC scores from the previous school year using independent sample t-tests. Descriptive statistics tables accompanied the data for analysis. The dependent variable was student EOC scores and the independent variable was the treatment. Results obtained from the analyses was assessed and interpreted with a 95 percent confidence interval.

Chapter Four: Findings

Methods Overview

This research was designed to supplement the current literature regarding technology in the classroom and possible impact, if any, on student outcomes. More specifically, this study was a comparison of course teaching practices and student academic outcomes in traditional lecture versus modified flipped Algebra I classrooms. As stated earlier, the target high school had four teachers randomly assigned by a building administrator to participate in the study. The four teachers taught a total of 393 freshman students during the 2013-14 school year. Teachers A and B were assigned the modified flipped classroom while teachers C and D were assigned the traditional lecture classroom. Students were randomly assigned either the traditional lecture or modified flipped treatment via *PowerSchool* student information software.

Teacher A taught six sections of modified flipped classes with approximately 30 students in each section. Teacher B taught one section of class-within-a-class (CWC) special education with 23 students, 11 of those had individual education plans (IEP) for mathematics services while the remaining were regular education students. Teacher B was the main teacher who instructed the class while an additional special education teacher assisted the 11 special education students. Teachers A and B had a total of 197 students who received the modified flipped instructional practice.

Teachers C and D taught the remaining 196 students via traditional lecture practices. Teacher C taught six sections of lecture with approximately 30 students in each section while teacher D taught one section of CWC with 22 students, 11 of those had IEP's for mathematics services while the remaining were regular education students. Teacher D was the primary instructor who instructed the class while another special education teacher assisted the 11 special

education students.

Teacher Interview Responses

For this section, teacher interview responses begin by re-stating each research question and all four teachers' responses to the questions.

- *How did you begin each class? What percent of the time did you lecture to the whole class? Describe what you did in class on an average day.*

Teacher A reported beginning each class period approximately 95 percent of the time by answering student questions from the class Google Doc forum. This consumed anywhere from 10 – 30 minutes but, on average, it was usually under 20 minutes. After answering student questions at the SMART board, she would assign students 15-30 mathematics problems to complete individually or collaboratively with a partner. No more than three students were allowed in each group.

- *Describe the typical classroom seating arrangement. Were students in rows, small groups, pods, or another configuration?*

Students had assigned seats throughout the school year. Desks were arranged in rows so two students could easily slide their desks together for collaboration when working assigned mathematics problems. Students were generally assigned partners by the teacher during collaboration time to reduce the chance of friends fraternizing instead of legitimate peer-to-peer instruction. Thus, the teacher arranged students so they could slide beside their neighbor and collaborate. This reduced off-task behavior during transitioning.

- *What percent of the time did you work problems in class? What percent of the time did students do assigned mathematics problems in class? What percent of the time did you answer students questions in class?*

Teacher A reported answering mathematics problems or solving sample problems approximately 10 – 30 minutes in class but on average it was usually under 20 minutes. After answering student questions at the SMART board, she would assign students 15-30 mathematics problems to complete individually or collaboratively with a partner. Students worked on assigned mathematics problems in class on average 30 minutes or less.

When asked how often students were allowed to work with a partner versus working alone, teacher A responded it was usually 60/40 split with 60 percent collaboration. If students could appropriately work with a partner and use collaborative learning as it was intended with minimal relevant noise level, she would permit it.

As stated earlier in the literature review, collaborative learning in the modified flipped context is defined as teachers providing guided instruction and feedback to students in an interactive style. For this study, students engaged with peers or teachers performing mathematics problem analysis. By engaging in meaningful collaborative activities, students interact with their partner and more knowledgeable adults. This interaction is the catalysts for learners to develop conversations within the confines of in-class activities. Throughout this exchange of ideas and information, students generate and develop an increased understanding and depth of knowledge regarding the content. As a result, student learning and cognitive development emerge.

However, teacher A reported she did not always use collaborative learning. If the noise level was excessive or students had off-topic conversations they worked solitarily. She stated

morning classes could usually work collaboratively but afternoon classes were not as successful. They worked alone more often than not. Usually, after the 20-minute unstructured lunchtime, she found it difficult for students to work collaboratively and stay on topic. Teacher A reported she wanted students to collaborate but often had classroom management difficulties in the afternoon and her only option was individual work.

- *Describe your perceptions of student academic behavior in class. (Where students more or less prepared when they came to class?)*

Teacher A reported less than 5 percent of the time re-teaching any lessons by lecture. The overwhelming majority of students came to class with a relatively firm grasp of the content requiring minor to moderate assistance with very specific concepts. This conclusion was based on teacher A's perceptions and the relationships she developed over time with students. It was not based on paper or electronic checklist, survey, or log she recorded daily, but rather on her perception of narrowly defined applicable questions students posted on the Google Doc forum implying they were consistently viewing her instructional videos. Additionally, teacher A reported, on average, 70-80 percent of students completed their assigned mathematics problems in class each day suggesting they were completing outside class activities and more prepared academically for class. When asked about the percentage of students who completed assigned problems before class dismissal during previous years, teacher A reported 20-30 percent on average. The increased number of students completing assigned problems in class suggested they were more prepared for class compared to previous classes taught via lecture.

- *What percent of students do you believe read the prior knowledge questions before viewing the web-based video on an average day? What percent of students do you believe genuinely and consistently watched the online video before class on an average*

day? How do you know they read the prior knowledge questions and watched the video? Did you have a daily checklist, survey, or log? Was it based on teacher impression of each student? Was encouraging students to read the prior knowledge questions and view the video a consistent problem?

Teacher A was asked about student participation in outside class activities. Her perception was that, on average, approximately 90-95 percent of students read the prior knowledge questions, earnestly viewed the web-based instructional videos, and posted substantive questions to the class Google Doc forum. This was not based on a paper or electronic checklist, survey, or log recorded daily, but rather on her perception of narrowly defined applicable questions students posted on the Google Doc forum suggesting they consistently viewed her instructional videos. Additionally, teacher A reported, on average, 70-80 percent of students completed their assigned problems in class each day which also reinforced they completed out-of-class class activities. Teacher A's perception was that student participation in out-of-class activities was not an ongoing problem.

- *After students viewed the online video, how many questions were posted to the Google Doc forum on average each day? What percent of students posted at least one relevant question on average each day?*

Teacher A's perception about student participation in out-of-class activities, on average, was approximately 90-95 percent of the time. This included reading prior knowledge questions, earnestly viewing the online video, and posting at least one relevant question on the Google Doc forum.

- *How much time did you spend on average implementing all three components (creating and posting prior knowledge questions, creating and posting web-based instructional videos, reading and utilizing student Google Doc questions to guide subsequent lessons) of the modified flipped classroom? Describe the instructional video making process? Did teachers take turns creating instructional videos or did the same teacher make all the instructional videos? How much time was spent creating each video on average?*

All four teachers were asked to describe the process for making the web-based instructional videos. Since teachers A and B taught the modified flipped classroom, they made most of the instructional videos but teachers C and D assisted as needed. They helped with managing the YouTube account and uploading or editing instructional videos as required. Teacher A and B used the target school video recording cameras with accompanying tripods to produce videos in their classrooms before school, after school, or during their plan times. They reported taking turns recording instructional videos. Each produced about two or three videos per week and each video was no more than fifteen minutes. Teacher A and B reported writing scripts prior to recording their instructional videos. This reduced mutterings or long pauses. As the year progressed, they became more proficient and comfortable making videos and did not require detailed scripts. After a few weeks, teachers A and B reported their videos had a lot of substance compacted into a relatively short amount of time. The absence of student disruptions and classroom distractions made the instructional video presentations succinct. Toward the end of each video, the teacher summarized key points for students to reflect upon. If time permitted, they included a brief synopsis of the next video content. Teacher A and B were asked about the time consumed to create, edit, and upload each video. Both reported approximately 45 minutes for each video at the beginning of the year but improved their efficiency to less than 30 minutes

by the end of first semester. Of course, once videos are created, they can be shared with other Algebra I teachers and used in subsequent years eliminating the need to create new videos. The following are Teacher B's responses to the interview questions.

- *How did you begin each class? What percent of the time did you lecture to the whole class? Describe what you did in class on an average day.*

Teacher B reported beginning virtually every class by answering student questions posted on the web-based Google Doc forum. She stated, on average, this activity consumed approximately 10-30 minutes of class time. Teacher B answered student questions by solving problems or explaining key concepts. The length of time spent answering questions from the Google Doc forum was dictated by the difficulty of the lesson. Teacher B stated, on average, 90 percent of the time student questions could be sufficiently answered in less than 30 minutes and virtually never re-taught an entire lesson via traditional lecture.

Next, the regular education students worked on 15-30 assigned mathematics problems for the remainder of class. Some students with IEP's had less than ten assigned mathematics problems if their IEP permitted it. Reduced assignment conversations were usually initiated by the student to the teacher and often worked jointly to determine the appropriate number of mathematics problems.

- *Describe the typical classroom seating arrangement. Were students in rows, small groups, pods, or another configuration?*

Teacher B reported desks were in rows and students had assigned seats throughout the school year. They were permitted to move near different desks and work collaboratively when appropriate. After Teacher B finished answering Google Doc questions, IEP students moved to

the back of the room with tables and chairs. This made collaboration more convenient for students with IEP's.

- *What percent of the time did you work problems in class? What percent of the time did students do assigned mathematics problems in class? What percent of the time did you answer students questions in class?*

Teacher B reported approximately 10-30 minutes of class was spent solving problems in class from the Google Doc forum or answering questions. She answered student questions by solving problems or explaining key concepts. Students worked on assigned mathematics problems in class approximately 25 minutes. Teacher B reported, on average, 90 percent of the time students worked collaboratively on homework problems and 10 percent individually. The smaller class size with two teachers made collaborative learning easier to implement as intended by the target school. Students worked on homework collaboratively while teacher B circulated around the room answering questions, acting as a coach providing guidance and feedback. While the regular education students were working on mathematics problems, the 11 IEP students were with the special education teacher toward the back of the room. On average, 80 percent of the time she would split them into two groups. She answered questions for one group while the other group worked with a partner collaboratively to solve mathematics problems. She alternated between the two groups answering questions and providing guidance. On average, 20 percent of the time she addressed all 11 IEP students collectively if everyone struggled with similar concepts. Teacher B reported the small class size with two teachers allowed for more student freedom and easier classroom management so students could work collaboratively as intended.

- *Describe your perceptions of student academic behavior in class. (Were students more or less prepared when they came to class?)*

Her perception was 80 percent of the students came to class more prepared than when she taught the lecture version in previous years. Additionally, teacher B reported, on average, 70-90 percent of students completed their assigned problems before class dismissal and most students averaged higher test scores when compared to her past lecture classes. She estimated, at most, 50 percent completed assigned problems before class ended in previous lecture classes. Teacher B reported student academic behavior in class, on average, was well over half of the students attending class with average to above average knowledge of the lesson and most required minimal to moderate assistance with the lesson. This was based on her perception of student questions and feedback she received in class.

- *What percent of students do you believe read the prior knowledge questions before viewing the web-based video on an average day? What percent of students do you believe genuinely and consistently watched the online video before class on an average day? How do you know they read the prior knowledge questions and watched the video? Did you have a daily checklist, survey, or log? Was it based on teacher impression of each student? Was encouraging students to read the prior knowledge questions and view the video a consistent problem?*

Teacher B reported students completed all three out-of-class activities, on average, 85-95 percent. She based this on the quality of student Google Doc questions and how prepared they came to class. Not on a paper or electronic survey, log, or checklist. She reported virtually all of her students were consistent with out-of-class activities throughout the year.

- *After students viewed the online video, how many questions were posted to the Google Doc forum on average each day? What percent of students posted at least one relevant question on average each day?*

Teacher B reported, on average, 85-95 percent of students completed all three outside class activities. Her answer was based on the quality of student Google Doc questions and the relationship and work ethic perceptions she had regarding her students.

- *How much time did you spend on average implementing all three components (creating and posting prior knowledge questions, creating and posting web-based instructional videos, reading and utilizing student Google Doc questions to guide subsequent lessons) of the modified flipped classroom? Describe the instructional video making process? Did teachers take turns creating instructional videos or did the same teacher make all the instructional videos? How much time was spent creating each video on average?*

See teacher A's response.

The following are Teacher C's responses to the interview questions.

- *How did you begin each class? What percent of the time did you lecture to the whole class? Describe what you did in class on an average day.*

Teacher C reported her typical class began with bell work posted on the SMART board as students entered the class. Bell work consisted of 5-10 mathematics problems similar to the previous day's assigned problems. A timer was running which usually allotted 4 - 8 minutes to create a sense of urgency and reduce off-task behavior. After bell work and homework was collected, teacher C stated she would review some of the key concepts addressed in the bell work problems and allow questions regarding the previous day's homework. She reported these activities typically consumed, on average, 12-20 minutes.

The next activity involved teacher C lecturing the new lesson. She described this process as explaining key concepts, vocabulary words, formulas with their proofs, and a few sample problems. She used the SMART board to present lectures while students took notes. Teacher C reported this process consumed approximately 15-30 minutes depending on the difficulty of the lesson and student responses. Finally, the remaining time was reserved for students to work on assigned mathematics problems. She usually assigned between 15-30 problems and sometimes students worked alone or in groups of two collaboratively. Students, on average, had 20 minutes or less to work on their assignment in class. If students had closer to 20 minutes to work on problems, teacher C would permit them to work in groups of three or four. If five minutes or less remained, they usually worked alone since moving desks would leave limited time for collaboration.

However, teacher C reported similar classroom management challenges as teacher A. She stated two sections caused her significant difficulty managing behavior. As a result, teacher

C modified two sections of lecture. She retained the bell work part for the beginning 4 - 8 minutes of class along with reviewing key concepts from the previous lesson. She struggled with maintaining student attention and cooperation for her subsequent lecture. She reported excessive off-topic talking, cross-talking, constant pencil sharpening, using Kleenex, and students out of their seats without permission. Thus, her lectures were reduced from 15- 30 minutes to 5 – 10 minutes. After a 10 minute maximum lecture, she placed students in groups of three or four while she provided assistance. Teacher C reported trying to include at least one person in each group who grasped the content and they assisted the other students. She reported this was not her intent, but the difficulty with classroom management made it her only option to maintain some control over student behavior.

- *Describe the typical classroom seating arrangement. Were students in rows, small groups, pods, or another configuration?*

Teacher C reported students were given assigned seats in multiple rows. Students could slide their desk next to their neighbor or form small pods with four desks if permitted.

- *What percent of the time did you work problems in class? What percent of the time did students do assigned mathematics problems in class? What percent of the time did you answer students questions in class?*

Teacher C lecture combined with solving problems in class was approximately 15-30 minutes depending on the lesson difficulty and student responses. Students, on average, had 20 minutes or less to work on their assignment in class alone or in small groups.

Teacher C reported answering student questions on bell work problems and additional student questions in class, on average, 12-20 minutes.

- *Describe your perceptions of student academic behavior in class. (Were students more or less prepared when they came to class?)*

Teacher C was asked about her perceptions of student academic behavior from year-to-year.

She stated approximately 85-95 percent of students turned in assigned problems and bell work on time the following day. She reported homework grades and tests scores were very similar to previous year's students. Their overall academic preparedness was similar to previous years. Additionally, she reported there were usually one or two sections difficult to control behavior which forced her into adjusting teaching practices possibly influencing academic behavior.

The following are Teacher D responses to the interview questions.

- *How did you begin each class? What percent of the time did you lecture to the whole class? Describe what you did in class on an average day?*

Teacher D began each class with bell work on the SMART board consisting of 3 - 8 problems similar to previous homework. Students were allotted approximately 10-12 minutes for completion. After students turned in bell work and homework, she reviewed various key concepts in their homework and began preparing them for the next lesson. Her lesson addressed the entire class while the special education teacher listened in the back. Teacher D lectured about critical concepts, vocabulary words, formulas with their proofs, and a few sample problems. She used the SMART board to present her lecture while students were seated in assigned rows taking notes. Teacher D stated this practice was, on average, 10-30 minutes.

After lecturing, students were assigned 10-30 problems and the regular education students worked alone or with a partner. Teacher D circulated around the room providing assistance. Some students with IEP's had less than 10 mathematics problems if their IEP allowed it. Reduced assignments were usually initiated by the student to the teacher and they

worked together to determine the appropriate number of problems. IEP students were usually separated into two groups and moved to the back with the special education teacher for additional support. One group solved mathematics problems in groups of two or four while the other group received help from the special education teacher. She alternated between groups and provided assistance as needed. Students usually had between 5-30 minutes to work on mathematics problems before dismissal. Teacher D stated, on average, 70-80 percent of students turned in homework and bell work on time. She could not compare the percentage of students who successfully turned in homework and bell work on time or student homework grades and tests scores to previous years given that it was her first year at the target school.

- *Describe the typical classroom seating arrangement. Were students in rows, small groups, pods, or another configuration?*

Teacher D reported desks were in rows and students had assigned seats throughout the school year. They were permitted to relocate to different desks and work collaboratively when appropriate. After Teacher D finished answering questions, IEP students moved to the back of the room with tables and chairs. This made collaboration more convenient for students with IEP's.

- *What percent of the time did you work problems in class? What percent of the time did students do assigned mathematics problems in class? What percent of the time did you answer students' questions in class?*

Teacher D reported working problems and answering student questions in class, on average, 10-30 minutes. Students' time for completing in-class mathematics problems was dictated by teacher D's time lecturing and answering questions. Usually, students were allowed between 5-30 minutes to work on assigned problems before dismissal.

- *Describe your perceptions of student academic behavior in class. (Were students more or less prepared when they came to class?)*

Teacher D stated, on average, 70-80 percent of students turned in homework and bell work on time. She reported student academic behavior was mostly consistent throughout the school year. Student preparation for class remained constant. Teacher D could not compare her perception of student academic behavior in class to previous years since it was her first year at the target school. Also, she could not estimate the percentage of students who turned in assigned problems on time or compare tests scores to previous years.

EOC Data Collection

Target site students participating in the study were enrolled in the Algebra I course in August of 2013 and completed EOC testing in late April or early May of 2014 per state-sanctioned testing window. EOC tests were administered online unless students had an Individual Education Plan that permitted an online exception. These exceptions included braille, large print test booklet, or paper/pencil format. All of the students participating in this study completed their Algebra I EOC untimed test online. Following testing, each student received a raw score converted into a scaled score after a valid attempt. Scaled scores range were 100 to 250.

After all testing is completed, Questar Assessment Corporation compiles student answers and points earned to obtain Algebra I EOC scaled scores and convert them into performance ranks. Student outcomes on Algebra I EOC exams are reported in provisions of four performance ranks that express a path to proficiency. These four performance levels from lowest to highest are Below Basic, Basic, Proficient, and Advanced. Approximately two to three weeks after students completed their Algebra I EOC, exam results were mailed and emailed to the target district assigned testing coordinator. Scores are also reported to the state and used to calculate annual yearly progress reports for school districts.

Quantitative analysis of student Algebra I EOC data was conducted. EOC scores measured for possible statistical difference using independent sample t-tests with SPSS software. Students with nonwhite status, free/reduced lunch status, and those with IEP's were checked for significance using independent sample t-tests. Additionally, each teacher who taught a modified flipped or traditional lecture classroom had their students mean Algebra I EOC scores for 2013-14 school year compared to their students mean Algebra I EOC scores from the previous year using independent sample t-tests. Descriptive statistics tables accompanied data for analysis.

The dependent variable is student EOC scores and the independent variable is the treatment.

Results obtained from the analyses were assessed and interpreted with a 95 percent confidence interval.

EOC Data Findings

EOC Data during 2013-14 for Teacher A and B versus Teacher C and D

This section compared student outcomes, as measured by EOC scores, between the two types of teaching practices. It also measured for possible differences between teacher's student outcomes, as measured by EOC, in modified flipped compared to the same teacher's student outcomes in the traditional lecture class. Before beginning this section it is important to indicate that at least one limitation of the statistical results is that they are based on different students who may or may not have varying abilities, backgrounds, etc. as related to learning Algebra I and that some sort of pre-treatment measure would have been helpful.

An independent-sample t-test was conducted to compare 2013-14 EOC scores in modified flipped and traditional lecture classrooms. Results concluded there was significant difference in the EOC scores between the two classrooms. There was significant difference in EOC scores for modified flipped ($M = 202.85$, $SD = 21.43$) and traditional lecture ($M = 195.45$, $SD = 30.30$) conditions; $t(350.95) = 2.795$, $p = .005$. These results suggested that student outcomes were higher for students receiving the modified flipped treatment compared to their counterparts in the traditional lecture context. Descriptive statistics and independent sample t-test data can be found below.

Table 1					
<i>Descriptive Statistics</i>					
EOC Scores in 2013-14					
<u>Teaching Practice</u>	<u>N</u>	<u>Mean</u>	<u>Std. Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped	197	202.858	21.43524	160.00	249.00
Traditional Lecture	196	195.454	30.30144	122.00	243.00
Total	393	199.165	26.46167	122.00	249.00

Table 1 shows the mean for the modified flipped class was $m = 202.85$ with a sample size of 197 and standard deviation of 21.43. The traditional lectures mean was $m = 195.45$ with a sample size of 196 and standard deviation of 30.30. The traditional lecture class had a larger standard deviation than modified flipped. This implied the students had a much different reaction to the traditional lecture treatment. The range and spread of EOC scores was wider for traditional lecture students. Modified flipped students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for modified flipped was 89 and traditional lecture was 121.

Table 1 (con't.)

Independent Samples Test

Levene's Test for Equality of Variances

						<u>95 percent Confidence Interval of the Difference</u>	
<u>EOC Scores 2013- 14</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2- tailed)</u>	<u>Lower</u>	<u>Upper</u>
Equal variances assumed	12.097	0.001	2.797	391	0.005	2.20025	12.6073
Equal variances not assumed			2.795	350.957	0.005	2.19398	12.6136

Table 1 (cont.) shows the Independent Samples Test. This data uses the Levene's Test for Equality of Variances to verify if the two conditions from Table 1 (condition 1 = Modified Flipped; condition 2 = Traditional Lecture) have similar or different amounts of variability between EOC scores. Values in columns F and Sig. are used to determine which row to interpret for measuring statistical significance. Sig. values that are $p > .050$ signify the variability in the two conditions are not significantly different and equal variances are assumed. Thus, the top row was used for measuring statistical significance. Sig. values that are $p \leq .05$ signifies the variability in the two conditions was significantly different so equal variance were not assumed. Thus, the bottom row was used for measuring statistical significance. A Sig. (2-tailed) $p \leq .050$ represents statistical significant difference between mean EOC scores and Sig. (2-tailed) $p > .050$ represents no statistical difference in mean EOC scores.

Another method for verifying statistical significant difference is by the "95 percent Confidence Interval of Difference" on the far right side of Table 1 cont. When zero is not included between the lower and upper bounds, the test has statistical significant differences as

confirmed by the p value. Additionally, when zero is included in the lower and upper bounds, the test is not statistically significant.

When interpreted, the results from Table 1 (cont.) the Leven's test Sig. = .001 shows equal variances not assumed so the bottom row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, there was no zero value in the confidence interval which also confirmed the statistical significant difference in EOC scores.

EOC Data for Teacher A vs. Teacher C during 2013-14

An independent-sample t-test was conducted to compare 2013-14 EOC scores for teacher A in a modified flipped and teacher C in a traditional lecture classroom. Results concluded there was significant difference in the EOC scores between the two classrooms. There was significant difference in EOC scores for modified flipped ($M = 207.18$, $SD = 18.81$) and traditional lecture ($M = 202.73$, $SD = 23.08$) conditions; $t(332.45) = 1.973$, $p = .049$. These results suggested that student outcomes were higher for students receiving the modified flipped treatment from teacher A compared to their counterparts in the traditional lecture from teacher C. Descriptive statistics and independent sample t-test data can be found below.

Table 2					
<i>Descriptives</i>					
EOC Scores for Teacher A vs. Teacher C during 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher A	174	207.19	18.81562	177.00	242.00
Lecture Teacher C	174	202.736	23.0884	147.00	243.00
Total	348	204.963	21.1482	147.00	243.00

Table 2 shows the mean for modified flipped teacher A was $m = 207.18$ with a sample size of 174 and standard deviation of 18.81. Traditional lecture teacher C had a mean of $m = 202.73$ with a sample size of 174 and standard deviation of 23.08. Traditional lecture teacher C had a larger standard deviation than modified flipped teacher A. This implied the students had a much different reaction to teacher C's traditional lecture treatment. The range and spread of EOC scores were wider for teacher C's traditional lecture students. Teacher A's modified

flipped students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher A was 65 and teacher C was 96.

Table 2 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores 2013-14</u>					<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>		<u>Lower</u>	<u>Upper</u>
Equal variances assumed	4.467	0.035	1.973	346	0.049	0.01301	8.89504
Equal variances not assumed			1.973	332.457	0.049	0.01238	8.89567

When interpreted, the results from Table 2 (cont.) the Leven's test Sig. = .035 shows equal variances not assumed so the bottom row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, there was no zero value in the confidence interval which also confirmed the statistical significant difference in EOC scores.

EOC Data for Teacher B vs. Teacher D Regular Education Students during 2013-14

An independent-sample t-test was conducted to compare 2013-14 regular education EOC scores for teacher B in modified flipped and teacher D traditional lecture classrooms. Results concluded there was no significant difference in the EOC scores between the two classrooms. There was no significant difference in regular education EOC scores for modified flipped ($M = 190.00$, $SD = 23.257$) and traditional lecture ($M = 179.54$, $SD = 30.80$) conditions; $t(21.00) = .924$ $p = .366$. These results suggested that student outcomes were not higher for regular education students receiving the modified flipped treatment from teacher B compared to their counterparts in the traditional lecture from teacher D. Descriptive statistics and independent sample t-test data can be found below.

Table 3					
<i>Descriptives</i>					
EOC Regular Education Scores for Teacher B vs. Teacher D for during 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher B	12	190.00	23.25745	156.00	231.00
Lecture Teacher D	11	179.546	30.80053	135.00	234.00
Total	23	185.00	27.02188	135.00	234.00

Table 3 shows the mean for modified flipped teacher B was $m = 190.00$ with a sample size of 12 and standard deviation of 23.25. Traditional lecture teacher D had a mean of $m = 179.54$ with a sample size of 11 and standard deviation of 30.80. Traditional lecture teacher D had a larger standard deviation than modified flipped teacher B. This implied the students had a much different reaction to teacher D's traditional lecture treatment. The range and spread of

EOC scores were wider for teacher D's traditional lecture students. Teacher B's modified flipped students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher B was 75 and teacher D was 99.

Table 3 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	0.294	0.593	0.924	21	0.366	-13.0812	33.9903
Equal variances not assumed			0.912	18.573	0.373	-13.5678	34.4768

When interpreted, the results from Table 3 (cont.) the Leven's test Sig. = .593 shows equal variances assumed so the top row was used for interpretation. $P > .050$ so there was no statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was no statistical significant difference in EOC scores.

Teacher A EOC Data Comparison between 2012-13 and 2013-14

An independent-sample t-test was conducted to compare students EOC scores who were taught via lecture by teacher A during 2012-13 and students Algebra I EOC scores who were taught via modified flipped by teacher A during 2013-14 school year. Results concluded there were no significant difference in teacher A's EOC scores when comparing the 2012-13 and 2013-14 school years. There was no significant difference in students EOC scores who were taught by teacher A 2012-13 ($M = 202.93$, $SD = 26.94$) and students EOC scores taught by teacher A during 2013-14 ($M = 206.88$, $SD = 18.92$) conditions; $t(319.63) = 1.599$, $p = .111$. These results suggested that teacher A's EOC scores during the 2012-13 school year had no significant difference in outcomes compared to the 2013-14 school year. Descriptive statistics and independent sample t-test data can be found below.

Table 4					
<i>Descriptives</i>					
EOC Scores for Teacher A for 2012-13 and 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Lecture 2012-13	179	202.933	26.94409	129.00	242.00
Modified Flipped 2013-14	174	206.881	18.92972	177.00	242.00
Total	353	204.89	23.36862	129.00	242.00

Table 4 shows the mean for teacher A in 2012-13 was $m = 202.93$ with a sample size of 179 and a standard deviation of 26.94. Teacher A in 2013-14 had a mean of $m = 206.88$ with a sample size of 174 and standard deviation of 18.92. Teacher A in 2012-13 had a larger standard deviation than teacher A in 2013-14. This implied the students had a much different reaction to teacher A in 2012-13. The range and spread of EOC scores were wider for teacher A in 2012-13.

Teacher A's 2013-14 students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher A in 2012-13 was 113 and teacher A in 2013-14 was 65.

Table 4 (con't.)

Independent Samples Test

Levene's Test for Equality of Variances

						<u>95 percent Confidence Interval of the Difference</u>	
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2- tailed)</u>	<u>Lower</u>	<u>Upper</u>
Equal variances assumed	13.107	.000	1.595	353	0.112	- 0.92038	8.81582
Equal variances not assumed			1.599	319.637	0.111	- 0.90815	8.80359

When interpreted, the results from Table 4 (cont.) the Leven's test Sig. = .000 shows equal variances not assumed so the bottom row was used for interpretation. $P > .050$ so there was no statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was no statistical significant difference in EOC scores.

EOC Data for Teacher A vs. Teacher C during 2012-13

An independent-sample t-test was conducted to compare 2012-13 EOC scores between teacher A's and teacher C's traditional lecture classrooms. Results concluded there was significant difference in the EOC scores between the two classrooms. There was significant difference in traditional lecture EOC scores for teacher A ($M = 202.93$, $SD = 26.94$) and teacher C ($M = 190.68$, $SD = 23.75$) conditions; $t(58.923) = 2.212$, $p = .031$. These results suggested that student outcomes were higher for teacher A's students receiving the traditional lecture compared to teacher C in the traditional lecture. Descriptive statistics and independent sample t-test data can be found below.

Table 5					
<i>Descriptives</i>					
EOC Scores for Teacher A vs. Teacher C During 2012-13					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Traditional Lecture Teacher A	179	202.933	26.94409	129.00	242.00
Traditional Lecture Teacher C	47	190.681	23.75041	137.00	242.00
Total	226	196.805	25.35323	129.00	242.00

Table 5 shows the mean for teacher A was $m = 202.93$ with a sample size of 179 and standard deviation of 26.94. Teacher C had a mean of $m = 190.68$ with a sample size of 47 and standard deviation of 23.75. Teacher A had a larger standard deviation than teacher C. This implied the students had a much different reaction to teacher A's traditional lecture treatment. The range and spread of EOC scores were wider for teacher A's traditional lecture students.

Teacher C's students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher A was 113 and teacher C was 105.

Table 5 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
Equal variances assumed	16.969	0.000	2.68	224	0.008	3.25128	21.32
Equal variances not assumed			2.212	58.923	0.031	1.17145	23.3998

When interpreted, the results from Table 5 (cont.) the Leven's test Sig. = .000 shows equal variances not assumed so the bottom row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was not in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for Teacher C 2013-14 vs. Teacher C during 2012-13

An independent-sample t-test was conducted to compare Algebra I EOC scores for 2012-13 teacher C's traditional lecture and 2013-14 teacher C's traditional lecture. Results concluded there was no significant difference in the EOC scores between the two classrooms. There was no significant difference in EOC scores for 2012-13 teacher C ($M = 190.68$, $SD = 23.75$) and 2013-14 teacher C ($M = 202.73$, $SD = 23.08$) conditions; $t(59.403) = 1.995$, $p = .051$. These results suggested that student outcomes in Algebra I were not higher for 2012-13 teacher C's students receiving traditional lecture and 2013-14 teacher C's students in the traditional lecture. Descriptive statistics and independent sample t-test data can be found below.

Table 6					
<i>Descriptives</i>					
EOC Scores for 2012-13 Teacher C vs. 2013-14 Teacher C					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std. Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Teacher C 2013-14	174	202.736	23.0884	147.00	243.00
Teacher C 2012-13	47	190.681	23.75041	137.00	242.00
Total	221	196.705	23.43363	137.00	243.00

Table 6 shows the mean for 2012-13 teacher C was $m = 190.68$ with a sample size of 47 and standard deviation of 23.75. Teacher C in 2013-14 had a mean of $m = 202.73$ with a sample size of 174 and standard deviation of 23.08. Teacher C in 2012-13 had a slightly larger standard deviation than teacher C in 2013-14. This implied the students had a different reaction to teacher C in 2012-13 treatment. The range and spread of EOC scores were wider for teacher C in 2012-13. Teacher C during 2013-14 had a slightly lower standard deviation so students had a more

consistent reaction to the treatment. The range for teacher C during 2012-13 was 105 and teacher C during 2013-14 was 96.

Table 6 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	14.459	0.00	2.405	219	0.017	1.88754	19.0249
Equal variances not assumed			1.995	59.403	0.051	-0.02793	20.9404

When interpreted, the results from Table 6 (cont.) the Leven's test Sig. = .000 shows equal variances not assumed so the bottom row was used for interpretation. $P > .050$ so there was no statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was no statistical significant difference in EOC scores.

EOC Data for Students Eligible for Free/Reduced Lunch

An independent-sample t-test was conducted to compare 2013-14 Algebra I EOC scores for students eligible for free/reduced lunches in modified flipped and traditional lecture classrooms. Results concluded there was significant difference in the EOC scores between the two classrooms. There was significant difference in EOC scores for modified flipped ($M = 203.29$, $SD = 24.81$) and traditional lecture ($M = 187.02$, $SD = 32.17$) conditions; $t(85) = 2.617$, $p = .010$. These results suggested that students eligible for free/reduced lunches had higher outcomes in Algebra I when they received the modified flipped treatment compared to their counterparts in the traditional lecture classroom. Descriptive statistics and independent sample t-test data can be found below.

Table 7					
<i>Descriptives</i>					
EOC Scores for Free/Reduced Lunches during 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped	41	203.293	24.81355	162.00	249.00
Traditional lecture	46	187.022	32.17486	124.00	228.00
Total	87	194.69	29.91317	124.00	249.00

Table 7 shows the mean for modified flipped was $m = 203.29$ with a sample size of 41 and standard deviation of 24.81. Traditional lecture had a mean of $m = 187.0$ with a sample size of 46 and standard deviation of 32.17. Traditional lecture had a larger standard deviation than modified flipped. This implied the students had a much different reaction to the traditional

lecture treatment. The range and spread of EOC scores were wider for traditional lecture students. Modified flipped students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for modified flipped was 87 and traditional lecture was 104.

Table 7 (con't.)

Independent Samples Test

Levene's Test for Equality of Variances

<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	2.986	0.088	2.617	85	0.010	3.91047	28.631420
Equal variances not assumed			2.656	83.344	0.009	4.08824	28.45365

When interpreted, the results from Table 7 (cont.) the Leven's test Sig. = .088 shows equal variances assumed so the top row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was not in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for Free/Reduced Lunch Students Between Teacher A and Teacher C

An independent-sample t-test was conducted to compare 2013-14 Algebra I EOC scores for students eligible for free/reduced lunches between Teacher A and Teacher C. Results concluded there was significant difference in the EOC scores between the two classrooms.

There was significant difference in EOC scores for Teacher A modified flipped ($M = 207.81$, $SD = 22.53$) and traditional lecture ($M = 196.34$, $SD = 21.17$) conditions; $t(69) = 2.211$, $p = .030$.

These results suggested that 2013-14 EOC scores for Teacher A's students eligible for free/reduced lunches had higher outcomes compared to Teacher C's counterparts in the traditional lecture classroom. Descriptive statistics and independent sample t-test data can be found below.

Table 8					
<i>Descriptives</i>					
EOC Scores for Free/Reduced Lunch Students Between Teacher A and Teacher C during 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher A	33	207.818	22.53117	156.00	239.00
Lecture Teacher C	38	196.342	21.1753	144.00	228.00
Total	71	201.676	22.41223	144.00	239.00

Table 8 shows the mean for teacher A was $m = 207.81$ with a sample size of 33 and standard deviation of 22.53. Teacher C had a mean of $m = 196.34$ with a sample size of 38 and standard deviation of 21.17. Teacher A and C had very similar standard deviations which

implied both groups had a consistent reaction to the treatment. The range of both teachers was also very similar. The range for Teacher A was 83 and for teacher C was 84.

Table 8 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
Equal variances assumed	0.228	0.634	2.211	69	0.03	1.12088	21.8313
Equal variances not assumed			2.201	66.222	0.031	1.06713	21.885

When interpreted, the results from Table 8 (cont.) the Leven's test Sig. = .634 shows equal variances assumed so the top row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was not in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for Free/Reduced Lunch Students Between Teacher B versus Teacher D Regular Education During 2013-14

An independent-sample t-test was conducted to compare 2013-14 regular education students eligible for free/reduced lunch EOC scores for teacher B's modified flipped and teacher D's traditional lecture classrooms. Results concluded there was no significant difference in the EOC scores between the two classrooms. There was no significant difference in regular education free/reduced lunch EOC scores for modified flipped ($M = 187.75$, $SD = 13.22$) and traditional lecture ($M = 184.00$, $SD = 14.54$) conditions; $t(7) = .399$, $p = .701$. These results suggested that student outcomes were not higher for regular education students eligible for free/reduced lunches receiving the modified flipped treatment from teacher B compared to their counterparts in the traditional lecture from teacher D. Descriptive statistics and independent sample t-test data can be found below.

Table 9					
<i>Descriptives</i>					
EOC Scores for Free/Reduced Lunch Students Between Teacher B and Teacher D During 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher B	4	187.75	13.22561	178.00	206.00
Lecture Teacher D	5	184.00	14.54304	169.00	201.00
Total	9	185.667	13.2382	169.00	206.00

Table 9 shows the mean for teacher B was $m = 187.75$ with a sample size of 4 and standard deviation of 13.22. Teacher D's regular education students only had a mean of $m = 184.00$ with a sample size of 5 and standard deviation of 14.54. Teacher D had a slightly larger

standard deviation than teacher B. This implied the students had very consistent reactions to both treatments. The range for teacher B was 28 and teacher D was 32.

Table 9 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
						<u>95 percent Confidence Interval of the Difference</u>	
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2- tailed)</u>	<u>Lower</u>	<u>Upper</u>
Equal variances assumed	0.493	0.505	0.399	7	0.701	- 18.44722	25.94722
Equal variances not assumed			0.404	6.823	0.698	- 18.29829	25.79829

When interpreted, the results from Table 9 (cont.) the Leven's test Sig. = .505 shows equal variances assumed so the top row will be used for interpretation. $P > .050$ so there was no statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was no statistical significant difference in EOC scores.

Teacher A EOC Data for Students Eligible for Free/Reduced Lunch

An independent-sample t-test was conducted to compare teacher A's 2012-13 and 2013-14 EOC scores for students eligible for free/reduced lunches. Results concluded there was no significant difference in the EOC scores between the two school years. There was no significant difference in EOC scores for 2012-13 ($M = 199.74$, $SD = 28.77$) and 2013-14 ($M = 195.57$, $SD = 31.81$) conditions; $t(72) = -.592$, $p = .555$. These results suggested that students eligible for free/reduced lunches did not have significant differences in 2013-14 when they received the modified flipped treatment compared to their 2012-13 counterparts in the traditional lecture classroom. Descriptive statistics and independent sample t-test data can be found below.

Table 10					
<i>Descriptives</i>					
Teacher A Free/Reduced Lunch EOC Scores for 2012-13 and 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher A 2013-14	33	195.571	31.81129	156.00	239.00
Lecture Teacher A 2012-13	39	199.744	28.77016	165.00	238.00
Total	72	197.77	30.10964	156.00	239.00

Table 10 shows the mean for modified flipped was $m = 195.57$ with a sample size of 33 and standard deviation of 31.81. Traditional lecture had a mean of $m = 199.74$ with a sample size of 39 and standard deviation of 28.77. Modified flipped had a larger standard deviation than traditional lecture. This implied the students had a much different reaction to the modified

flipped treatment. The range and spread of EOC scores were wider for modified flipped students. Traditional lecture students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for modified flipped was 83 and traditional lecture was 73.

Table 10 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	0.562	0.456	-0.592	72.00	0.555	-18.2101	9.86575
Equal variances not assumed			-0.589	68.98	0.558	-18.2979	9.95358

When interpreted, the results from Table 10 (cont.) the Leven's test Sig. = .456 shows equal variances assumed so the top row was used for interpretation. $P > .050$ so there was no statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was no statistical significant difference in EOC scores.

EOC Data for Regular Education Free/Reduced Lunch Students for Teacher A versus Teacher C During 2012-13.

An independent-sample t-test was conducted to compare traditional lecture 2012-13 free/reduced lunch EOC scores for teacher A's and teacher C's regular education classrooms. Results concluded there was significant difference in the EOC scores between the two classrooms. There was significant difference for traditional lecture free/reduced lunch students EOC scores during 2012-13 teacher A ($M = 199.74$, $SD = 28.77$) and teacher C ($M = 177.00$, $SD = 21.12$) conditions; $t(8.172) = -2.236$, $p = .048$. These results suggested that student outcomes were higher for regular education students eligible for free/reduced lunches from teacher A compared to their counterparts in the traditional lecture from teacher C. Descriptive statistics and independent sample t-test data can be found below.

Table 11					
<i>Descriptives</i>					
EOC Scores for Regular Education Free/Reduced Lunch Students Between Teacher A and Teacher C during 2012-13					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Lecture Teacher A 2012-13	39	199.744	28.77016	4.60691	165.00
Lecture Teacher C 2012-13	6	177.00	21.12818	8.62554	149.00
Total	45	196.711	28.75257	4.28618	149.00

Table 11 shows the mean for teacher A was $m = 199.74$ with a sample size of 39 and standard deviation of 28.77. Teacher C's regular education students had a mean of $m = 177.00$ with a sample size of 6 and standard deviation of 21.12. Teacher A had a larger standard

deviation than teacher C. This implied the students had a much different reaction to teacher A's treatment. The range and spread of EOC scores were wider for teacher A's students. Teacher C's students had a lower standard deviation so they had a more consistent reaction to the treatment. The range for teacher A was 73 and teacher C was 62.

Table 11 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	5.597	0.023	-1.853	43	0.071	-47.49642	2.00924
Equal variances not assumed			-2.326	8.172	0.048	-45.21104	-0.27614

When interpreted, the results from Table 11 (cont.) the Leven's test Sig. = .023 shows equal variances assumed so the bottom row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for Non-Whites

An independent-sample t-test was conducted to compare 2013-14 EOC scores for nonwhite students in modified flipped and traditional lecture classrooms. Results concluded there was significant difference in the EOC scores between the two classrooms. There was significant difference in EOC scores for modified flipped ($M = 204.76$, $SD = 29.23$) and traditional lecture ($M = 191.39$, $SD = 31.40$) conditions; $t(78) = 2.037$, $p = .045$. These results suggested that nonwhite students had higher outcomes when they received the modified flipped treatment compared to their counterparts in the traditional lecture classroom. Descriptive statistics and independent sample t-test data can be found below.

Table 12					
<i>Descriptives</i>					
EOC Scores for Non-Whites During 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std. Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped	42	204.762	29.23397	155.00	248.00
Traditional lecture	38	191.395	31.40724	128.00	230.00
Total	80	198.413	30.3206	128.00	248.00

Table 12 shows the mean for modified flipped was $m = 204.76$ with a sample size of 42 and standard deviation of 29.23. Traditional lecture had a mean of $m = 191.39$ with a sample size of 38 and standard deviation of 31.40. Traditional lecture had a larger standard deviation than modified flipped. This implied the students had a different reaction to the traditional lecture

treatment. The range and spread of EOC scores were wider for traditional lecture students. Modified flipped students had a lower standard deviation so they had a more consistent reaction to the treatment. The range for modified flipped was 93 and traditional lecture was 102.

Table 12 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	0.275	0.601	2.037	78	0.045	0.30018	26.43415
Equal variances not assumed			2.036	77.112	0.045	0.2939	26.44044

When interpreted, the results from Table 12 (cont.) the Leven's test Sig. = .601 shows equal variances assumed so the top row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was not in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for Non-Whites Comparing Teacher A and Teacher C During 2013-14

An independent-sample t-test was conducted comparing EOC scores between nonwhite students in teacher A's modified flipped and teacher C's traditional lecture classrooms during 2013-14. Results concluded there was significant difference in the EOC scores between the two classrooms. There was significant difference in EOC scores for modified flipped ($M = 204.05$, $SD = 23.60$) and traditional lecture ($M = 193.60$, $SD = 18.21$) conditions; $t(66) = 2.035$, $p = .046$. These results suggested that nonwhite students had higher outcomes when they received the modified flipped treatment from teacher A compared to their counterparts in the traditional lecture classroom from teacher C. Descriptive statistics and independent sample t-test data can be found below.

Table 13					
<i>Descriptives</i>					
EOC Scores for Non-Whites Comparing Teacher A and Teacher C During 2013-14					
Teachers	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher A	35	204.057	23.60825	154.00	242.00
Lecture Teacher C	33	193.606	18.21905	158.00	230.00
Total	68	198.985	21.65778	154.00	242.00

Table 13 shows the mean for teacher A was $m = 204.05$ with a sample size of 35 and standard deviation of 23.60. Teacher C had a mean of $m = 193.60$ with a sample size of 33 and standard deviation of 18.21. Teacher A had a larger standard deviation than Teacher C. This

implied the students had a much different reaction to the modified flipped treatment. The range and spread of EOC scores were wider for modified flipped students. Traditional lecture students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher A was 88 and teacher C was 72.

Table 13 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-</u>	<u>95 percent</u> <u>Confidence</u> <u>Interval of the</u> <u>Difference</u>	
					<u>tailed)</u>	<u>Lower</u>	<u>Upper</u>
Equal variances assumed	2.955	0.090	2.035	66	0.046	0.19661	20.7056
Equal variances not assumed			2.050	63.569	0.044	0.26665	20.63552

When interpreted, the results from Table 13 (cont.) the Leven's test Sig. = .090 shows equal variances not assumed so the bottom row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was not in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for Regular Education Non-Whites Comparing Teacher B and Teacher D During 2013-14

An independent-sample t-test was conducted comparing EOC scores for regular education nonwhite students for teacher B in modified flipped and teacher D in traditional lecture classrooms during 2013-14. Results concluded there was no significant difference in EOC scores between the two classrooms. There was no significant difference in EOC scores for modified flipped ($M = 196.25$, $SD = 24.58$) and traditional lecture ($M = 175.16$, $SD = 25.46$) conditions; $t(8) = 1.299$, $p = .230$. These results suggested that regular education nonwhite students did not have higher outcomes when they received the modified flipped treatment from teacher B compared to their counterparts in the traditional lecture classroom from teacher D. Descriptive statistics and independent sample t-test data can be found below.

Table 14					
<i>Descriptives</i>					
EOC Scores for Regular Education Non-Whites Comparing Teacher B and Teacher D During 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std. Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher B	4	196.25	24.5815	167.00	226.00
Lecture Teacher D	6	175.167	25.46697	151.00	216.00
Total	10	183.6	26.08192	151.00	226.00

Table 14 shows the mean for teacher B's regular education students was $m = 196.25$ with a sample size of 4 and standard deviation of 24.58. Teacher D's regular education students had a mean of $m = 175.16$ with a sample size of 6 and standard deviation of 25.46. Teacher D had a

larger standard deviation than Teacher B. This implied teacher D's students had a different reaction to the traditional lecture treatment. The range and spread of EOC scores were wider for traditional lecture students. Modified flipped students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher B was 59 and teacher D was 65.

Table 14 (con't.)

Independent Samples Test

Levene's Test for Equality of Variances

<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	0.114	0.744	1.299	8	0.230	-16.33592	58.50259
Equal variances not assumed			1.31	6.754	0.233	-17.26563	59.43230

When interpreted, the results from Table 14 (cont.) the Leven's test Sig. = .744 shows equal variances assumed so the top row was used for interpretation. $P > .050$ so there was no statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was no statistical significant difference in EOC scores.

EOC Data for Non-Whites Comparing Teacher A during 2012-13 and 2013-14

An independent-sample t-test was conducted comparing EOC scores for nonwhite students for teacher A in modified flipped during 2013-214 and teacher A in traditional lecture classrooms during 2012-13. Results concluded there was significant difference in EOC scores between the two classrooms. There was significant difference in EOC scores for modified flipped ($M = 204.0571$, $SD = 23.608$) and traditional lecture ($M = 191.926$, $SD = 24.99$) conditions; $t(74) = 2.028$, $p = .046$. These results suggested that nonwhite students did have higher outcomes when they received the modified flipped treatment from teacher A during 2014-2013 compared to their counterparts in the traditional lecture classroom from teacher A during 2012-13. Descriptive statistics and independent sample t-test data can be found below.

Table 15					
<i>Descriptives</i>					
EOC Scores for Non-Whites during 2013-14 Modified Flipped Teacher A and Traditional Lecture Teacher A 2012-13					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped Teacher A 2013-14	35	204.057	23.60825	154.00	242.00
Lecture Teacher A 2012-13	41	191.927	24.99839	146.00	238.00
Total	76	197.912	26.83344	146.00	242.00

Table 15 shows the mean for teacher A in 2013-14 was $m = 204.05$ with a sample size of 35 and standard deviation of 23.60. Teacher A in 2012-13 had a mean of $m = 191.92$ with a sample size of 41 and standard deviation of 24.99. Teacher A in 2012-13 had a larger standard

deviation than Teacher A in 2013-14. This implied teacher A's 2012-13 students had a different reaction to the traditional lecture treatment. The range and spread of EOC scores were wider for Teacher A's 2012-13 traditional lecture students. Teacher A's 2013-14 students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher A in 2013-14 was 88 and teacher A in 2012-13 was 92.

Table 15 (con't.)

Independent Samples Test

Levene's Test for Equality of Variances

<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
						<u>Lower</u>	<u>Upper</u>
Equal variances assumed	0.955	0.332	2.028	74	0.046	0.21639	24.33
Equal variances not assumed			2.012	69.210	0.048	0.10197	24.44437

When interpreted, the results from Table 15 (cont.) the Levene's test Sig. = .332 shows equal variances assumed so the top row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was not in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for Non-Whites Comparing Teacher A and Teacher C During 2012-13

An independent-sample t-test was conducted comparing EOC scores for nonwhite students for teacher A and teacher C in traditional lecture classrooms during 2012-13. Results concluded there was significant difference in EOC scores between the two classrooms. There was significant difference in EOC scores for teacher A ($M = 191.92$, $SD = 24.99$) and traditional lecture ($M = 175.83$, $SD = 25.356$) conditions; $t(51) = 2.021$, $p = .049$. These results suggested that nonwhite students had higher outcomes when they received the lecture treatment from teacher A compared to their counterparts in teacher C classroom. Descriptive statistics and independent sample t-test data can be found below.

Table 16					
<i>Descriptives</i>					
EOC Scores for Non-Whites Comparing Teacher A and Teacher C During 2012-13					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std.</u> <u>Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Lecture Teacher A 2012-13	41	191.927	24.99839	146.00	238.00
Lecture Teacher C 2012-13	12	175.833	21.3577	156.00	227.00
Total	53	188.283	24.96873	146.00	238.00

Table 16 shows the mean for teacher A was $m = 191.92$ with a sample size of 41 and standard deviation of 24.99. Teacher C had a mean of $m = 175.83$ with a sample size of 12 and standard deviation of 21.35. Teacher A's students had a larger standard deviation than Teacher C's students. This implied teacher A's students had a different reaction to the traditional lecture treatment. The range and spread of EOC scores were wider for Teacher A's traditional lecture

students. Teacher C's students had a lower standard deviation so students had a more consistent reaction to the treatment. The range for teacher A was 92 and teacher C was 71.

Table 16 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
Equal variances assumed	0.242	0.625	2.021	51	0.049	Lower	Upper
Equal variances not assumed			2.205	20.676	0.039	0.90286	31.2841

When interpreted, the results from Table 16 (cont.) the Leven's test Sig. = .625 shows equal variances assumed so the top row was used for interpretation. $P < .050$ so there was statistical significant difference in EOC scores. Additionally, the zero value was not in the confidence interval which also confirmed there was statistical significant difference in EOC scores.

EOC Data for IEP Students

An independent-sample t-test was conducted to compare 2013-14 EOC scores for students receiving IEP mathematics services in modified flipped and traditional lecture classrooms. Results concluded there was no significant difference in the EOC scores between the two classrooms. There was no significant difference in EOC scores for modified flipped ($M = 187.09$, $SD = 22.95$) and traditional lecture ($M = 189.18$, $SD = 22.23$) conditions; $t(20) = -.217$, $p = .830$. These results suggested that students receiving IEP mathematics services had no difference in outcomes when they received the modified flipped treatment compared to their counterparts in the traditional lecture classroom. Descriptive statistics and independent sample t-test data can be found below.

Table 17					
<i>Descriptives</i>					
EOC Scores for IEP Students During 2013-14					
<u>Teachers</u>	<u>N</u>	<u>Mean</u>	<u>Std. Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Modified Flipped	11	187.091	22.95846	160.00	226.00
Traditional lecture	11	189.182	22.23429	155.00	225.00
Total	22	188.136	22.08058	155.00	226.00

Table 17 shows the mean for modified flipped IEP students was $m = 187.09$ with a sample size of 11 and standard deviation of 22.95. Traditional lecture had a mean of $m = 189.18$ with a sample size of 11 and standard deviation of 22.23. Modified flipped and traditional lecture students had nearly consistent standard deviations. This implied both groups responded

consistently to the treatments. The range and spread of EOC scores were virtually similar for both groups. Modified flipped student range was 66 and traditional lecture was 70.

Table 17 (con't.)							
<i>Independent Samples Test</i>							
Levene's Test for Equality of Variances							
<u>EOC Scores</u>	<u>F</u>	<u>Sig.</u>	<u>t</u>	<u>df</u>	<u>Sig. (2-tailed)</u>	<u>95 percent Confidence Interval of the Difference</u>	
Equal variances assumed	0.136	0.716	-0.217	20	0.830	-22.192	18.0102
Equal variances not assumed			-0.217	19.979	0.830	-22.1933	18.0115

When interpreted, the results from Table 17 (cont.) the Leven's test Sig. = .716 shows equal variances assumed so the top row was used for interpretation. $P > .050$ so there was no statistical significant difference in EOC scores. Additionally, the zero value was in the confidence interval which also confirmed there was no statistical significant difference in EOC scores.

Chapter Five: Discussions

Conclusions, Limitations, and Recommendations

Chapter Five will discuss conclusions, limitations, and recommendations based upon results of qualitative and quantitative data. Conclusions describing the extent of differences in teacher practices, methods, and student classroom experiences in modified flipped versus the traditional lecture classroom will be discussed. Findings of possible differences in student outcomes as measured by Algebra I EOC scores will be examined. Statistical significance findings regarding nonwhite students, free/reduced lunch, and IEP status will be presented. Lastly, a comparison of teachers' students outcomes in modified flipped compared to the same teachers' students outcomes in traditional lecture will be described.

Limitations will be explored as well. This study is a relatively small-scaled preliminary experimental trial conducted over a nine-month school year. Any results cannot be generalized to all student populations across the nation, state, or communities. Due to the subjectivity of teacher reporting, potential bias, and perceptions, data about student fidelity may not be completely accurate. Teacher perceptions about student fidelity to the program regarding out-of-class activities are subjective since no checklists, surveys, or logs were utilized. Thus, an accurate illustration of modified flipped practices was somewhat difficult to narrowly define and verify.

Furthermore, when determining the extent of student outcomes, a large range of factors were considered. For instance, student factual knowledge, applicable skills, student attitudes, and practical matters such as student retention in academic programs or graduation rates should be considered. Unfortunately, concrete data on how an instructional methodology impacts all of these learning outcomes is frequently not available, making widespread evaluations impractical. This study only examined three areas. First, teaching practices were assessed to determine if

teachers were indeed teaching the modified flipped class and traditional lecture as designed and also student fidelity to the program. Secondly, student Algebra I EOC data was examined quantitatively and possible statistical changes in student outcomes were measured. Thirdly, EOC scores between teachers will be compared during 2013-14 and 2013-2012 school years. Results were used to help determine the possible impact of modified flipped learning.

Recommendations for additional research on technology as an instructional tool and its possible influences on student outcomes are strongly encouraged. School leaders should acknowledge that an increasing number of schools are experimenting with some critical elements of flipped learning. Consequently, administrators ought to be aware of these changes and proper usage of technology in classrooms for appropriate teacher and student training on flipped learning practices that might impact outcomes.

Teaching Practice Conclusions

This section will discuss teaching practices used by all four teachers with analysis. The purpose is to determine how closely the teachers followed the target site steps for proper implementation of modified flipped learning as defined by school administrators. This section is important to the study given that reliable conclusions are a function of teacher fidelity to the teaching practice assigned to them. If teachers are not following the appropriate methodology on a consistent basis, student outcomes may be compromised. The first research question addressed in this section is the following:

- 1) How do teacher practices, methods, and student classroom experiences in modified flipped classrooms compare to the traditional lecture classroom?

Teacher A reported the following findings based upon interview questions. On average, 95 percent of the time, teacher A began class by answering student questions from the web-based Google Doc forum, as the modified flipped practice was intended by the target school. These were typically residual questions after they viewed the web-based instructional video prior to class. This practice consumed between 10-30 minutes, but average was less than 20 minutes. The remaining 30 minutes or so was reserved for students to work on typically 15-30 assigned mathematics problems individually or collaboratively. Student desks were arranged in assigned rows so they could collaborate by sliding their desks together the second part of class. Teacher A reported about 60 percent of the time students worked collaboratively. However, sometimes the noise level was excessive or conversations were not mathematics related so students worked alone. Teacher A reported most of the time the morning classes could appropriately collaborate but classes after lunch were not as successful with partners. On average, 40 percent of the time students used classroom time to solve assigned problems individually due to classroom management issues by teacher A. The absence of consistent student collaboration conflicts with the intended teaching practice of the target school for modified flipped classes. The lack of student interaction with peers and adults reduces the exchange of ideas, information, and increased knowledge. Consequently, students may fail to generate and develop an increased understanding and depth of knowledge regarding the Algebra content. Without the collaboration component, modified flipped learning may not impact student outcomes as intended by the target site.

Teacher A also reported lecturing the entire class or re-teaching a lesson during class about 5-10 percent of the time. This practice is generally discouraged in modified flipped since students receive the bulk of instruction in web-based out-of-class instructional videos. In-class

time is reserved for answering questions or assisting students with assigned problems or Algebraic concepts while the teacher circulated throughout the room. The teacher acted as a guide or coach that facilitated learning while shifting the learning responsibility to the student as opposed to the teacher-centered method.

Regarding posting prior knowledge questions and instructional videos to the appropriate internet forum, teacher A reported completing this task consistently. The only exception for this process was if students tested the following day. She also reported reading student Google Doc questions concerning the web-based YouTube instructional video virtually all the time before class and using them to guide subsequent class sessions. Teacher A reported a “few times” she did not read student questions before class but it was very rare. In those isolated cases she began class by asking questions and answering them at the SMART board.

In order for modified flipped methodology to function correctly, students must consistently participate in out-of-class activities. Teacher A’s perception about student participation in outside class activities was that, on average, 90-95 percent of students were reading the prior knowledge questions, actively viewing the web-based YouTube instructional videos, and posting relevant questions to the class Google Doc forum. Her perception was derived upon narrowly defined substantive questions posted on the Google Doc forum which demonstrated students consistently viewed online videos. Additionally, her perception was based upon the quality and frequency of questions students asked in subsequent classes, completed mathematics problems with correct answers, and student performance on in-class tests. She reported not keeping a written or electronic log, survey, or checklist regarding this data.

Moreover, teacher A reported, on average, 70-80 percent of students completed assigned

mathematics problems in class which reinforced her perception they completed outside class activities compared to only 20-30 percent completing mathematics problems before class dismissal in previous years. The increased percentage of students completing assigned mathematics problems with modified flipped methodology in class suggested they may be more prepared for class. In previous years, students received the content through in-class lectures reducing time for in class collaboration and support from adults. Teacher A perception concluded, on average, most of her students were consistently completing all or most outside class activities throughout the school year.

Lastly, teacher A reported her perception of teaching modified flipped classes with fidelity, on average, 75-80 percent of the time and her perception of student fidelity was 80-85 percent. Teacher A reported her lower fidelity was driven by a lack of student collaborative learning in afternoon classes due to classroom management struggles. Absent the student distractions, her perception of fidelity to the program would be virtually all the time. Her perception of student fidelity was 80-85 percent due to a lack of student collaboration in afternoon classes.

Teacher B was assigned to teach one section of CWC (class-within-a-class) Algebra I modified flipped. Her class contained 23 students, 11 had IEP's for mathematics services and the remaining 12 were regular education. Teacher B reported beginning nearly every class by answering student questions posted on the web-based Google Doc forum. On average, this consumed approximately 10-30 minutes of class time. Typically, teacher B answered student Google Doc questions by solving problems or explaining key concepts on the SMART board and time spent responding to student questions was dictated by the lesson difficulty. Teacher B reported, on average, 90 percent of all student questions were sufficiently answered in less than

30 minutes and never had to re-teach an entire lesson via traditional lecture methods.

After responding to Google Doc forum questions, regular education students solved 15-30 assigned mathematics problems for the remainder of class time. Desks were arranged in equally spaced rows so students could move to a different desk and work collaboratively. On average, 90 percent of the time students worked collaboratively on assigned problems as designed and the other 10 percent was individual work. While students worked on mathematics problems, Teacher B circulated around the room answering questions and acted as a coach providing guidance and feedback. As the regular education students solved mathematics problems, IEP students moved to the back of the room with the special education teacher. On average, 80 percent of the time IEP students were split into two groups. She answered questions for one group while the other group solved problems collaboratively. The special education teacher alternated between the two groups answering questions and providing assistance. The other 20 percent of the time she addressed all 11 IEP students collectively if they struggled with a common concept. Teacher B reported the small class size with two teachers permitted more student freedom so they successfully worked collaboratively.

Teacher B was asked questions regarding student and teacher participation in the experimental trail. She reported nearly always posting online prior knowledge questions, instructional videos on YouTube, and reading student Google Doc questions before class and using them as an instructional guide. The web-based instructional video and prior knowledge questions were always available to students online by 4:00 PM unless students were testing the following day. When asked how often students successfully completed all three outside class activities, Teacher B estimated on average 85-95 percent. Teacher B based her perception on the quality of student Google Doc questions and how prepared they came to class. Her perception

was that 80 percent of the students came to class more prepared than when she taught the lecture version of Algebra I in previous years. Additionally, teacher B reported, on average, 70-90 percent of students completed their assigned problems before class dismissal and the majority of students averaged higher test scores when compared to her past lecture classes. She estimated, at most, 50 percent completed mathematics problems before class ended in previous lecture classes. Teacher B also reported that, on average, over half of students came to class with moderate to elevated knowledge content of the lesson and most required minimal to modest assistance with the lesson. She reported teaching the class with fidelity virtually all the time and her perception of student fidelity was on average 85-95 percent.

Teacher C taught six sections of traditional lecture with approximately 30 students per section. Her typical class began with 5 – 10 bell work problems reviewing the previous day's homework posted on the SMART board as students entered class. A timer allotted 4 – 8 minutes to create a sense of urgency reducing off-task behavior. After bell work and homework was collected, Teacher C stated she would review key concepts addressed in the bell work problems and also answer questions regarding previous day's homework. She reported these activities typically consumed on average 12-20 minutes.

Next, teacher C lectured about the new lesson. She described this process as explaining key concepts, vocabulary words, formulas with their proofs, and a few sample problems. She used the SMART board to present lectures while students were seated in assigned equally spaced rows taking notes. Teacher C reported this process consumed, on average, 15-30 minutes depending on the difficulty of the lesson and student responses. Lastly, remaining class time was reserved for students to work on assigned mathematics problems. She usually assigned between 15-30 problems and sometimes students worked alone or in groups of two. Students on average

had 20 minutes or less to work on their assignment in class. If students had closer to 20 minutes to work, Teacher C would permit them to work in groups of three or four. If five minutes or less remained, they usually worked alone.

Teacher C reported she typically used the above practice for all six sections. However, two sections caused her significant difficulty with classroom management. Thus, teacher C modified two sections of Algebra I lecture. She retained the bell work part for the first 4 – 8 minutes of class along with reviewing key concepts from the previous lesson. However, she struggled with maintaining student attention and cooperation for her subsequent lecture. As a result, lectures were reduced from 15 to 30 minutes to less than 10 minutes. After a 10 minute maximum lecture, students worked in groups of three or four and they solved assigned problems while she circulated and provided assistance. She reported trying to include at least one person in each group who grasped the content so they could assist the other students. Teacher C reported this was not her intent, but the difficulties with classroom management made her feel it was the only option. She also admitted an absence of mathematics related conversations occurring during this time. Since teacher C could not appropriately manage the class, she confessed that group work masqueraded as student learning when little if any mathematics work occurred. If a supervisor observed her during this time, it was easier to defend student conversations when they were situated in groups as opposed to cross-talking or not working at all. When asked to compare and contrast her experiences lecturing previous years with this year she reported similar experiences. Teacher C stated, on average, 85-95 percent of students turned in homework and bell work on time. Homework grades and tests scores were also very similar to previous year's students. She also reported a few classes that were difficult to manage student behavior so she compensated by altering teaching methodology.

Teacher D taught one section of lecture CWC Algebra I with 22 students, 11 had an IEP for mathematics services and the other 11 were regular education. The 2013-14 school year was teacher D's first year at the target site. She reported similar teaching procedures to teacher C. Each class began with bell work on the SMART board consisting of 3 – 8 problems similar to previous homework and students were allowed approximately 10-12 minutes for completion. After students turned in bell work and homework, teacher D reviewed various key concepts in the homework and began preparing them for the next lesson. Teacher D's lecture addressed the entire class while the special education teacher listened in the back. Teacher D lectured about critical concepts, vocabulary words, formulas with their proofs, and a few sample problems. She used the SMART board to present lectures while students were seated in assigned rows taking notes. Teacher D stated this process was, on average, 10-30 minutes.

After lecturing, students were typically assigned 10-30 mathematics problems and the regular education students were allowed to work alone or with a partner while teacher D assisted students. Special education students moved to the back of the room with the special education teacher for additional support. The IEP students were generally split into two groups. One group worked on homework problems while the other group received help from the special education teacher. She would alternate between groups providing assistance as needed. Students usually had between 5-30 minutes to work on homework before dismissal. Teacher D stated, on average, 70-80 percent of students turned in homework and bell work on time. Teacher D could not compare the percentage of students who turned in homework and bell work on time or homework grades and tests scores to previous years since it was her first year at the target school.

It is important to note a common criticism of flipped learning web-based delivery

instruction. Critics argue students can receive lecture content in class under teacher supervision to reduce or eliminate distractions. Next, teachers used the remaining class time for collaboration or individual work on assigned problems. Detractors also suggest students can be distracted at home watching a video on their laptop if not monitored by an adult. This is especially true if they live in an environment not conducive to learning.

Proponents of flipped learning practices counter with students using their laptop at remote locations like public libraries, school libraries, local stores, or various outlets that offer quiet locations to view a 15 minute video. The video can be rewind, paused, or fast-forward to assist students with absorbing content which is difficult in a lecture context. The video may also increase student engagement so subsequent classes with more student content knowledge may lead to better collaboration and attention. Students who lack content knowledge or less engagement may be more likely to create distractions in class. They would rather disrupt the class then appear mentally deficient in a captive educational setting among peers.

Proponents of flipped learning suggest that in-class lectures can be very distracting even with adult supervisor. For example, students out of their seats without permission, students entering and exiting the class, teacher redirecting off-task students and behavior, pervasive student talking, and noises from electronic devices like phones. These same distractions may occur in modified flipped as well but proponents of flipped learning argue the student centered engagement with minimal lecture time and collaborative learning reduces off-task behavior. Additionally, distractions are reduced given that students are more prepared and engaged in the learning process. Furthermore, proponents argue in-class teacher-centered lectures lack student engagement and may be ineffective for a generation reared on laptops, tablets, internet, Wi-Fi, and mobile devices. Consequently, teacher-centered practices may reduce student engagement

levels compared to a student-centered flipped learning model that may reduce in-class distractions.

One last criticism of modified flipped learning is the third web-based component. This is a feature utilized by teacher A and teacher B. This part required students to post questions about the web-based instructional video. Student participation and legitimate effort can be subjective since it is based on teacher perception. After a few weeks or months of modified flipped practices, students can become bored with the repetitive nature. Consequently, they may not invest much effort in their engagement. When students post remaining questions about the video, they may lack substance. For example, suppose a lesson is on the quadratic equation. A few students could duplicate another students answer but with a few changes to make it appear authentic. A student could post a question stating the following:

I don't understand how to solve $2x^2 + 10x + 6 = 0$

Another student could use the same template while changing the coefficients and post the following question:

I don't understand how to solve $3x^2 + 6x + 3 = 0$

Yet another student could use the same template while changing the coefficients again and post the following question:

I don't understand how to solve $x^2 + 6x + 3 = 0$

All three questions are basically the same and have little substance. It may be difficult for a teacher to detect or may not have reported it in her perceptions of student engagement and substantive questions regarding the third component of modified flipped learning.

Finally, all four teachers' perception about their fidelity to the program may not be accurate. Teacher A and teacher B may have been the influenced by external pressures. Both

teachers A and B who taught modified flipped classes may have intentionally skewed their results during interviews. Since this was a school initiative and were directed by their supervisor to implement modified flipped learning as designed by the target school, they may have felt pressure to provide answers during the interview that were not fully accurate. Both reported their perception of fidelity to the program was very high. These results may be accurate or the teachers may have intentionally overinflated their participation percentages. Both teachers may fear possible retaliation or attracting attention from a supervisor they would rather avoid. This anxiety may have caused them to misrepresent their percentage of fidelity to modified flipped practices producing inaccurate data.

EOC Data Conclusions

This section will discuss EOC data conclusions for the 2012-13 and 2013-14 school years. The purpose was to determine if teacher A and teacher B modified flipped practices produced different outcomes compared to teacher C and teacher D lecture practices. Additionally, EOC data was used to make comparisons between teachers in the modified flipped and traditional lecture context for the 2012-13 and 2013-14 school year. Results determined if student outcomes were based upon the teaching practice or if other factors are possibly responsible. The second and third research questions addressed in this section are the following:

- (2) How do student outcomes, as measured by Missouri End of Course (EOC) exam scores, compare in the two types of classes?
- (3) To what extent are there differences between teacher's student outcomes, as measured by the EOC, in modified flipped compared to the same teacher's student outcomes in the traditional lecture class?

Before moving forward with EOC conclusions, it is important to define “external factors” since it was used as a source for some possible causes in Tables 18, 19, and 20. Berliner and Glass (2014) suggest less than 30 percent of student success is coupled with schools. Teachers and teaching practice are only one element of the 30 percent. Student success is most strongly connected with other factors such as socioeconomic status, language and language complexity at home, community dynamics, adequate medical care, physical and psychological home environment, family stability, access to books, games, or other activities that prepare children for school. If external factors are listed as a possible cause, than outcomes may be unrelated to teacher competency or teacher practices.

EOC data was compiled and checked for possible student outcome differences between modified flipped and traditional lecture treatment groups. Results produced mixed or inconclusive findings and suggested observed difference in scores may not be attributed to the use of the modified flipped format. A total of 17 independent sample t-tests were conducted to check for statistical significant differences between student outcomes for two treatment groups during two school years. The first six made overall general comparisons, the next five made comparisons for students eligible for free/reduced lunches, the next five made comparisons for nonwhite students, and the last t-test measured for significance among IEP students. The first six independent-sample t-tests compared students EOC outcomes between modified flipped and traditional lecture are described below:

Table 18 found is a general comparison of all students EOC scores between modified flipped and traditional lecture as described in the following t-tests:

1. Modified Flipped Teacher A and B versus Traditional Lecture Teacher C and D during 2013-14.
2. Modified Flipped Teacher A versus Traditional Lecture Teacher C during 2013-14.
3. Modified Flipped Teacher B versus Traditional Lecture Teacher D (IEP excluded) during 2013-14.
4. Modified Flipped Teacher A during 2013-14 versus Traditional Lecture Teacher A during 2012-13.
5. Traditional Lecture Teacher A versus Traditional Lecture Teacher C during 2012-13.
6. Traditional Lecture Teacher C during 2013-14 versus Traditional Lecture Teacher C during 2012-13.

Table 18

<i>Comparisons Between All Students</i>		
<u>Comparison</u>	<u>Statistical significance</u>	<u>Possible Causes</u>
Modified Flipped A&B vs. lecture C&D during 2013-14	Yes	Modified flipped methodology is better than lecture, teachers A & B are better teachers than teachers C & D, or external factors
Modified Flipped A vs. lecture C during 2013-14	Yes	Modified flipped methodology is better than lecture, teacher A is a better teacher than teacher C, or external factors
Modified Flipped B vs. lecture D (exclude IEP) 2013-14	No	Modified flipped is no better than lecture, or small sample size for teacher B = 12 and D = 11 may not be accurate.
Modified Flipped A 2013-14 vs. lecture A during 2012-13	No	Modified flipped had no impact - if modified flipped is better, modified flipped teacher A 2013-14 scores should be better than lecture teacher A 2012-13 scores.
Lecture A vs. lecture C during 2012-13	Yes-Teacher A is higher	Teacher A is a better teacher than C, disproportionate sample size (teacher A = 179 and C = 47) so results may not be accurate. External factors.
Lecture C 2013-14 vs. lecture C during 2012-13	No	No measurable difference between teacher C lecturing outcomes both years. Disproportionate sample size teacher C = 174 during 2013-14 and C = 47 during 2012-13 so results may not be accurate.

Row 1 examined the results of teachers A & B using modified flipped practices and compared it to traditional lecture teacher C & D. Results suggested significant differences did exist in EOC scores between the modified flipped and traditional lecture classrooms during the 2013-14 school year. There were significant differences in EOC scores for modified flipped ($M = 202.85$, $SD = 21.43$) and traditional lecture ($M = 195.45$, $SD = 30.30$) conditions; $t(350.95) = 2.795$, $p = .005$.

Closer inspection of the data provided more insight into student outcomes using Table 18. Since teacher A and C had much larger sample sizes compared to teacher B and teacher D, additional scrutiny between teachers A and C may provide more insight. Row 2 shows a comparison between teacher A and teacher C during 2013-2014. Teacher A modified flipped ($M = 207.18$) compared to teacher C lecturing ($M = 202.73$) produced significant differences in EOC scores which suggested teacher A may be a better teacher, modified flipped may be a better treatment, or external factors are dictating the outcomes. Row 5 compared teachers A lecturing ($M = 202.93$) and teacher C lecturing ($M = 190.68$) in 2012-13 and produced significant differences. This also suggested teacher A is a better teacher or external factors may be responsible. The comparison of teacher A during 2013-14 and teacher A during 2013-12 with different teaching practices produced no significance which suggested modified flipped is no better than lecturing based upon student EOC outcomes.

Additionally, after comparing row 2 and row 5 the mean gap between teachers A and C narrowed during the treatment year as compared to the previous year. During 2013-14 teacher A and C had very narrow mean differences. Teacher A modified flipped ($M = 207.18$) and teacher C lecturing was ($M = 202.73$). During 2012-13 the same teachers had a very wide mean difference. Teacher A ($M = 202.93$) and teacher C was ($M = 190.68$) with both teachers

lecturing. Teacher C's mean scores increased significantly (from 190.68 during 2012-13 to 202.73 during 2013-14) even though both years teacher C used lecture format. Teacher C's significant increase from 2012-13 to 2013-14 may be determined by a few factors.

During 2012-13, teacher C taught two sections of CWC classes with nearly half of the students receiving services for mathematics disabilities with a small sample size of 47 students. During 2013-14, teacher C had regular education students with a sample size of 174. Since teacher C had nearly half of her students with mathematics disabilities during 2012-13 and no students with disabilities during 2013-14, the differences in capacity levels may be driving the significant increase in student outcomes. Also, some IEP students may have accommodations in their IEP's reducing the number of assigned problems. Students with mathematics disabilities may benefit from extra practice instead of less. The reduced problems for IEP students may drive lower outcomes. The disproportionate differences between data sets may also have distorted findings. Lastly, it may be neither of these scenarios and findings were dictated by external factors which suggested inconclusive results.

Table 19 found below is a general comparison of all EOC scores between modified flipped and traditional lecture students eligible for free/reduced lunches as described in the following t-tests:

1. Modified Flipped Teacher A and B versus Traditional Lecture Teacher C and D during 2013-14.
2. Modified Flipped Teacher A versus Traditional Lecture Teacher C during 2013-14.
3. Modified Flipped Teacher B versus Traditional Lecture Teacher D (IEP excluded) during 2013-14.
4. Modified Flipped Teacher A during 2013-14 versus Traditional Lecture Teacher A during 2012-13.
5. Traditional Lecture Teacher A versus Traditional Lecture Teacher C during 2012-13.

Table 19

<i>Comparisons Between Students Eligible for Free/Reduced Lunch</i>		
<u>Comparison</u>	<u>Statistical significance</u>	<u>Possible Causes</u>
Modified Flipped A&B vs. lecture C&D during 2013-14	Yes	Modified flipped methodology is better than lecture, teachers A & B are better teachers than teachers C & D, or external factors
Modified Flipped A vs. lecture C during 2013-14	Yes	Modified flipped methodology is better than lecture, teacher A is a better teacher than teacher C, or external factors
Modified Flipped B vs. lecture D (exclude IEP) 2013-14	No	Modified flipped is no better than lecture, or small sample size for teacher (B = 4 and D = 5) may not be accurate.
Modified Flipped A 2013-14 vs. lecture A during 2012-13	No	Modified flipped had no impact - if modified flipped is better, modified flipped teacher A 2013-14 scores should be better than lecture teacher A 2012-13 scores.
Lecture A vs. lecture C during 2012-13	Yes-Teacher A is higher	Teacher A is a better teacher than C, disproportionate sample size (teacher A = 39 and C = 6) so results may not be accurate. External factors.

Row 1 examined the results of teachers A & B using modified flipped practices and compared it to traditional lecture teacher C & D for students eligible for free/reduced lunches. Results suggested significance difference did exist in EOC scores for students eligible for free/reduced lunches in modified flipped compared to traditional lecture classrooms. There was significant difference in EOC scores for modified flipped ($M = 203.29$, $SD = 24.81$) and traditional lecture ($M = 187.02$, $SD = 32.17$) conditions; $t(85) = 2.617$, $p = .010$.

Closer inspection of the data provides more insight to student outcomes using Table 19. Row 2 shows a comparison between teacher A and teacher C during 2013-14. Teacher A compared to teacher C produced significant differences which suggested teacher A is better teacher, modified flipped is a better treatment or external factors. Row 3 did not produce significant difference which suggested the modified flipped had no influence on student outcomes. However, the student sample sizes were very small for teacher B ($n = 4$) and teacher D ($n = 5$). This may have influenced the findings. Additionally, row 4 compared teacher A both years and there was no significant differences in outcomes. This also suggested modified flipped had no influence on student outcomes. Row 5 compared teachers A and C lecturing in 2012-13 and produced significant differences. This suggested teacher A is perhaps a better teacher than C or external factors. However, the disproportionate sample size for teacher A ($n = 39$) and teacher C ($n = 6$) may have impacted the results. Thus, results appeared inconclusive and suggested observed difference in scores may not be attributed to the use of the modified flipped format. Table 19 lists a few possible causes for the findings.

Table 20 found below is a general comparison of all EOC scores between modified flipped and traditional lecture nonwhite students as described in the following t-tests:

1. Modified Flipped Teacher A and B versus Traditional Lecture Teacher C and D during 2013-14
2. Modified Flipped Teacher A versus Traditional Lecture Teacher C during 2013-14
3. Modified Flipped Teacher B versus Traditional Lecture Teacher D (IEP excluded) during 2013-14
4. Modified Flipped Teacher A during 2013-14 versus Traditional Lecture Teacher A during 2012-13
5. Traditional Lecture Teacher A versus Traditional Lecture Teacher C during 2012-13

Table 20

<i>Comparisons Between Nonwhite Students</i>		
<u>Comparison</u>	<u>Statistical significance</u>	<u>Possible Causes</u>
Modified Flipped A&B vs. lecture C&D during 2013-14	Yes	Modified flipped methodology is better than lecture, teachers A & B are better teachers than teachers C & D, or external factors
Modified Flipped A vs. lecture C during 2013-14	Yes	Modified flipped methodology is better than lecture, teacher A is a better teacher than teacher C, or external factors
Modified Flipped B vs. lecture D (exclude IEP) 2013-14	No	Modified flipped is no better than lecture, or small sample size for teacher (B = 4 and D = 6) may not be accurate.
Modified Flipped A 2013-14 vs. lecture A during 2012-13	Yes	Modified flipped is a better teaching practice than lecture or external factors.
Lecture A vs. lecture C during 2012-13	Yes-Teacher A is higher	Teacher A is a better teacher than C, disproportionate sample size (teacher A = 41 and C = 12) so results may not be accurate. External factors.

Row 1 examined the results of teachers A & B using modified flipped practices and compared it to traditional lecture teacher C & D for nonwhite students. Results suggested significant difference did exist in the EOC scores for nonwhite students in modified flipped compared to traditional lecture settings. There was significant difference in EOC scores for modified flipped ($M = 204.76$, $SD = 29.23$) and traditional lecture ($M = 191.39$, $SD = 29.40$) conditions; $t(78) = 2.037$, $p = .045$.

Closer inspection of the data provided further insight into student outcomes using Table 20. Row 2 shows a comparison between teacher A and teacher C during 2013-14. Analysis of these two teachers provided greater insight due to larger sample sizes compared to teacher B and teacher D with small sample sizes. Teacher A modified flipped ($M = 204.05$) compared teacher C lecturing ($M = 193.60$). These findings suggested modified flipped may be the better treatment, teacher A may be a better teacher, or external variables. Additionally, row 4 compared teacher A 2013-14 modified flipped ($M = 204.05$) and teacher A 2013-12 lecturing ($M = 191.92$) and there was significant differences in outcomes. This suggested modified flipped was the better treatment or external factors. Lastly, row 5 compared teachers A lecturing ($M = 191.92$) and C lecturing ($M = 175.83$) during 2012-13 and produced significant differences. This suggested teacher A is a better teacher or external variables. However, the disproportionate sample sizes for teacher A ($n = 41$) and teacher C ($n = 12$) may have influenced the findings. Inconclusive and mixed findings suggested modified flipped may not be a better teaching practice compared to lecturing. Table 20 summarizes these findings relating to methodology, student outcomes, and external variables.

Table 21 found below is a comparison of IEP student EOC scores between modified flipped and traditional lecture during 2013-14.

Table 21

<i>Comparisons Between IEP Students</i>		
<u>Comparison</u>	<u>Statistical significance</u>	<u>Possible Causes</u>
Modified Flipped B vs. lecture D 2013-14	No	Modified Flipped methodology is not better than lecture; small sample size of 11 in each group may not produce accurate results. Reduced mathematics problems per IEP accommodations may have negative effect and produced lower content knowledge. IEP students may need extra practice or at least the same practice as other students to master the content.

Table 21 examined the results of teacher B using modified flipped practices and compared it to traditional lecture teacher D for IEP students. Results suggested significance difference did not exist in EOC scores for students with IEP's for mathematics services in modified flipped and traditional lecture classrooms. There was no significant difference in EOC scores for modified flipped ($M = 187.09$, $SD = 22.95$) and traditional lecture ($M = 189.18$, $SD = 22.23$) conditions; $t(20) = -.217$, $p = .830$. Findings concluded students with IEP's for mathematics services in modified flipped and traditional lecture classrooms were not significantly higher when receiving modified flipped treatment compared to those in traditional lecture setting.

Based on results from Tables 18 and 19 findings appeared to be mixed or inconclusive which suggested observed difference in scores could not be attributed to the use of the modified flipped format. Both tables suggested students produced statistical differences when receiving modified flipped treatment versus the lecture treatment via all four teachers. Comparisons between teacher A modified flipped and teacher C lecture during 2013-14 produced significance for teacher A which suggested she is a better teacher, modified flipped is the better treatment, or external factors. Additionally, teacher A lecture and teacher C lecture during 2012-13 also produced significantly higher scores for teacher A which implied teacher A is a better teacher or external factors.

Teacher B modified flipped and teacher D (lecture excluding IEP) during 2013-14 did not produce significant differences. It is important to note some of the sample sizes for teacher D were very small which may have altered the findings. Also, teacher A modified flipped during 2013-14 and teacher A lecture during 2012-13 did not produce significant differences. This suggested the modified treatment had no impact compared to lecture. Overall, it is difficult to extrapolate modified flipped is the better teaching practice since findings were mixed and appeared inconclusive.

Based on results from Table 20, findings suggested modified flipped teaching practices may produce significantly better scores for nonwhites based upon data from all four teachers. However, comparisons between teacher A modified flipped and teacher C lecture during 2013-14 suggested teacher A is a better teacher, modified flipped is a better treatment, or external factors. Teacher A modified flipped 2013-14 compared to teacher A lecture during 2012-13 produced significant results for the modified flipped students which implied better treatment or external factors. Additionally, teacher A lecture and teacher C lecture during 2012-13 produced

significantly higher scores for teacher A which implied teacher A is better teacher or external factors. Teacher B modified flipped and teacher D (lecture excluding IEP) during 2013-14 did not produce significant differences. However, very small sample sizes were used in this comparison. Teacher B had four students and teacher D had six students so findings may not be accurate.

It is important to note teacher A consistently produced significant difference in outcomes compared to teacher C during 2013-14 school year in Tables 18, 19, and 20. This suggested teacher A may be better than teacher C given that she produced higher outcomes in modified flipped compared to traditional lecture. However, teacher A reported in the interview abandoning the collaborative learning component of modified flipped practice during afternoon classes due to difficulties with classroom management. Students practiced collaborative learning about 60 percent of the time and the other 40 percent they worked individually. If teacher A actually was better than teacher C, she would have adequate classroom management skills and use fidelity as intended. This process lowered fidelity to the program and compromised her results based upon target site expectations. Teacher A may not be better than teacher C since she practiced collaborative learning 60 percent of the time. Or, this may suggest teacher A, using collaborative learning only 60 percent of the time, may be an exceptional teacher even though she was only following fidelity part of the time. Her outstanding instructional skills were so remarkable full fidelity was unnecessary. Her excellent teaching skills and not the teaching practice may have caused the improved outcomes. Teacher A may be a better teacher than teacher C.

Moreover, teacher A and teacher C lectured during 2012-13. Teacher A produced significant higher outcomes than teacher C when modified flipped was not practiced. Once

again, this suggested teacher A may be better than teacher C. These conflicting results led to additional mixed and inconclusive findings regarding the effectiveness of modified flipped teaching practices on student outcomes. However, of all the t-tests conducted, the most consistent findings suggested non-whites did produce better outcomes when compared collectively to all students, free/reduced lunch students, and IEP students during 2013-14 school year. Overall, it is difficult to suggest modified flipped is a better teaching practice than traditional lecture.

Based on results from Table 21, findings suggested IEP students did not produce significantly better scores regardless of the treatment. Comparisons between teacher B modified flipped and teacher D lecture during 2013-14 produced no significant differences in outcomes. Since the sample sizes were 11 students per group, results may not be accurate. Larger data set comparisons were recommended for future studies with IEP students.

Of the five t-tests that were measured for nonwhites in Table 20 three showed modified flipped producing significantly better outcomes. Other categories, Table 18 (general comparison of everyone), Table 19 (free/reduced lunch), and Table 21 (IEP) students showed two or less t-tests that were significant in favor of modified flipped practices. A possible explanation for nonwhite students receiving three out of five significant differences for modified flipped treatment is the student-centered engagement component linked with modified flipped learning compared to the teacher-centered lecture. Engagement is characteristic of the actions in time and energy students perform in educationally focused activities that encourage participation in academic practices (Kuh, 2001). There is a growing body of evidence emphasizing the positive effect that student engagement has on increased student outcomes (Zepk & Leach, 2010). Some studies suggested that engagement may be especially critical for non-whites and economically

disadvantaged students (Haak, HilleRisLambers, Pitre & Freeman, 2011). Love, Hodge, Grandgenett & Swift (2014) findings suggested successful outcomes in secondary mathematics and science courses for nonwhites and poor students in both learning and academic achievement relies heavily upon student engagement levels. This includes the quantity and quality of participation. For example, interaction with teachers, collaboration with peers in class, student participation in active and collaborative learning environments, and the quantity of time students study and exploit technological resources are vital to quality participation (Pascarella & Terenzini, 2005). As stated earlier in the study, one reason for implementing modified flipped learning in Algebra I classes as opposed to other teaching practices was evidence associated with student centered settings and the potential to close the mathematics achievement gap between whites and nonwhites.

Additionally, similar studies have explored students' level of engagement and academic outcomes producing gains interrelated with the dynamics associated with race, ethnicity, and poverty (Jensen, Kummer & Godoy, 2015). Findings by Love, Hodge, Grandgenett & Swift (2014) suggest African-American and Hispanic students have improved academic outcomes with higher levels of engagement compared to whites are significant to this study. As a result, the possible improved student outcomes for nonwhites may be linked to the increased engagement via active learning and collaboration associated with modified flipped learning.

Conversely, outcomes for students receiving special education services in mathematics did not produce statistical significance. These findings suggested students with IEP's did not respond to the modified flipped treatment. To understand this, a review of teacher B responses to fidelity to the program may provide insight. Teacher B estimated all three out-of-class activities were completed by students 85-95 percent of the time. Teacher B based this on the

quality of student web-based Google Doc questions and how prepared they came to class. Her perception was that 80 percent of the students came to class more prepared than when she taught the lecture version of Algebra I in previous years. Teacher B also reported, on average, 70-90 percent of students completed their assigned problems before class dismissal and most students averaged higher classroom test scores compared to her past lecture classes. Furthermore, she estimated about 50 percent completed assigned problems before class ended in her previous year lecture classes and over half of students came to class with average to above average knowledge of the lesson while most required minimal to moderate assistance with the lesson. Finally, teacher B reported teaching the class with fidelity virtually all the time and her perception of student fidelity was on average 85-95 percent. Based upon teacher B statements, teacher and student fidelity to the program could be assumed sufficient. Thus, Teacher B's perceptions about student participation may be inaccurate, teacher B statements about her modified flipped teaching practices are inaccurate, or some combinations of both statements are inaccurate.

Another possible explanation for the lack of improved outcomes in modified flipped context may be dictated by students' mathematics disability. By definition, the students received special education mathematics services due to their learning disabilities and never responded to the modified flipped treatment. Also, some IEP students received accommodations for reduced problems. This may have a negative impact and produced lower content knowledge. IEP students may need extra practice or similar levels of practice as other students to master the content. Providing students who have mathematics disabilities reduced problems may be counterproductive. Furthermore, the small sample size makes it difficult to extrapolate empirically driven findings. More research with larger sample sizes is recommended to

determine whether students with mathematics learning disabilities respond to flipped learning practices.

Lastly, it is important to discuss possible explanations for mixed results or results which suggested outcomes were not attributed to the use of the modified flipped format. Tables 18, 19, and 20 suggested students produced statistical differences when receiving modified flipped treatment versus the lecture treatment via all four teachers. Comparisons between teacher A modified flipped and teacher C lecture during 2013-14 produced significance for teacher A which suggested she is a better teacher, modified flipped is the better treatment, or external factors. Additionally, teacher A lecture and teacher C lecture during 2012-13 also produced significantly higher scores for teacher A which implied teacher A is a better teacher or external factors. As mentioned earlier, findings in this study may have little if any connection to the treatment or quality of the teacher. Mixed results may be linked to external school factors. Berliner and Glass (2014) found there is a myth in the American education system suggesting teachers are the most important influence in a child's education. Their research is based on the findings below.

For some time now, there has been an ongoing narrative in the education establishment suggesting the impact teachers have on student outcomes. Good teachers do make a difference in student growth and bad teachers may impede learning. However, teachers are not the most important influence. Most research suggests less than 30 percent of student success is linked to school and teachers are only one element of a school. Student success is most strongly connected with other factors such as socioeconomic status, language and language complexity at home, community dynamics, adequate medical care, physical and psychological home environment, family stability, access to books, games, or other activities that prepare children for

school. These external school forces are unrelated to teacher competency or teacher practices. Outside forces may have as much as twice the influence at predicting student success compared to inside school forces of which teachers are a tiny part. Consequently, findings are not dictated by the teaching practice or quality of the teacher, but external school dynamics the school has little if any control.

Limitations

The study of the target school does have limitations. For example, this study is a relatively small-scaled preliminary experimental trial conducted over a nine month school year. Any results cannot be generalized to all student populations. Rather, the results only applied to the small sample of students and teachers who participated in this experimental trial and any findings are a function of student and teacher fidelity to the overall program.

Some t-tests had small sample sizes and others had disproportionate data sets limiting the study. For example, the IEP t-test during 2013-14 had a total of 22 participants and regular education teacher B verses teacher D during 2013-14 had 23 participants. Free/reduced lunch students between teacher B and teacher D during 2013-14 had 9 participants. Teacher B and teacher D regular education nonwhite students for 2013-14 had 10 participants. Some t-tests had disproportionate data sets as well. Teacher A and teacher C during 2012-13 had 179 and 47 respectively. Teacher A and teacher C during 2012-13 regular education free/reduced lunch students had 39 and 6 respectively. Nonwhite students between teacher A and teacher C during 2012-13 had 41 and 12 respectively. Small data sets and disproportionate sizes may limit the study.

The self-reported teacher interviews are also a limitation. Teacher fidelity to the program was based on their perception of suitable implementation on an average basis. Teachers may

sense external pressure to report high degrees of fidelity for fear of possible retaliation by supervisors. Moreover, student fidelity to the program was based upon teacher perception of consistent student participation in all three components of modified flipped learning. This aspect can be difficult to measure accurate data thus limiting the study. There is also the symbolic participation feature associated with student posting substantive questions on the Google Doc forum. Over time, students may become weary with the repetitive and repetitious nature of posting daily questions to a web-based forum. Students may duplicate their peers' questions undermining student fidelity.

In addition, only four teachers participated in the study. Two of the teachers instructed 348 of the 393, or 88 percent, of students in the study. The small number of teachers, coupled with half of them teaching a disproportionate number of students, placed limitations on findings and implications. Replicating these results using the defined parameters in this study may or may not produce similar results.

Furthermore, the comparison of teachers between 2013-14 and 2012-13 does provide some additional substance to the study. The added t-tests measuring individual teachers' student outcomes between school years and comparing their teaching practices across school years slightly bolstered findings. Since the study only includes EOC data for two school years, conclusive findings are difficult to defend. A 5 or 10 year longitudinal study using similar components may be beneficial. Findings may provide additional data that supports or contradicts this study. It is possible a 10 year longitudinal study would produce a cyclical nature associated with test scores over long periods of time. Since a new group of students take Algebra I each year, numerous external factors may impact their outcomes. Since these variables ebb and flow each school year, it is reasonable to assume EOC outcomes would gradually fluctuate over time.

Thus, the teaching practice and teacher have little if any impact on student outcomes; rather it is the cyclical nature of standardized test scores.

Recommendations

As traditional lecture practices come under increased scrutiny, school leaders may consider alternative teaching methodologies that may improve student outcomes and critical thinking skills. As flipped and modified flipped practices become more common and the cost to purchase and maintain technology decline, school leaders may find themselves increasing the exploration of flipped learning models in their schools. New electronic devices are constantly emerging to support the out-of-class component of school curriculum (Bell, 2015). More specifically, the continued expansion of affordable and powerful mobile devices will provide students with educational tools they can use at times and places most suitable for them. Critics may argue reading a chapter in a textbook before class is basically the same as flipped learning. However, they fail to recognize a generation reared on the internet, laptops, tablets, Wi-Fi, and mobile devices may not read a chapter before class. As stated earlier in this study, Johnson & Johnson (2009) findings on current high school students, also known as millennials 1981-1996, have distinctive learning preferences that diverge from past generations. Demetry (2010) analysis concluded millennial students prefer peer collaboration, active-based education, and technology infused curriculum. Kirschner, Strijbos, Kreijns & Beers (2004) findings suggested millennials favor instructors that foster collaboration with their classmates, incorporate technology in homework and instruction, and provide flexible learning settings. Proponents of flipped learning suggest interactive resources that engage students with technology outside of class and use in-class time for collaborative activities.

In the future, a typical school day may not consist of teachers using class time to convey a particular lesson solely through lecture or small group instruction. Rather, the use of

prerecorded asynchronous web-based videos and Google Doc forums places lectures under the power of the student. For example, they can watch, pause, rewind, and fast-forward as desired. This flexibility may be of value to students with accessibility concerns, particularly where closed captions are provided for students with hearing impairments. Online lectures can be viewed as often as needed may be beneficial for many students but especially favors English Language Learners. Moreover, class time can be transformed into a workshop where students ask about online video content, test their skills in practical applications, and network with other students in application activities (Bell, 2015). During in-class sessions, teachers use student questions from Google Doc forums to operate as guides or facilitator that encourage student inquiry and collaborative endeavors as opposed to traditional lectures that may not be effective for some students.

School administrators should acknowledge that an increasing number of high school courses are experimenting with some elements of flipped learning (Dixson, 2012). Essential components such as supplementing traditional out-of-class lecture with web-based instructional videos, capitalizing on supporting online resources such as Google Docs or Face Book forums, and incorporating technology into project-based learning during regular class times are becoming more pervasive in schools (Bell, 2015). As a result, practitioners in educational leadership should be knowledgeable of the ever changing advancements and correct usage of technology in classrooms so they can appropriately train teachers and students on the most effective methods of flipped learning that may impact student outcomes.

Next, a recommendation for additional research with larger stable data sets utilizing technology as an instructional tool and its possible impact on student outcomes is strongly encouraged. Computers coupled with internet access used to create flipped or modified flipped

instructional strategies are a relatively new phenomenon in education. The current limited research supporting the effectiveness, or lack thereof, of technology and its possible impact on student outcomes needs further research before legitimate long-term conclusions can be drawn. School leaders should proceed with caution before adopting wide-spread instructional methodologies using laptops or mobile devices as a key instructional tool.

Lastly, school leaders who decide to implement flipped learning practices, but lack the proper theoretical framework coupled with practical application, may struggle to properly employ it in their schools. Without proper implementation and adherence to methodological fidelity, flipped learning may become another education fad that fails to deliver on its promises. Consequently, instead of full compliance, it yields symbolic adoption by students and teachers reducing the chances of success and a return to traditional practices. However, even with a high degree of fidelity reported by teachers in this study, results were mixed or inconclusive. Thus, school personnel should proceed with restraint before considering implementation.

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